APPENDIX M GUIDE FOR ESTIMATING DRILL STEEL AND DRILL BIT COSTS

Guide for Estimating Drill Steel and Drill Bit Costs

Prepared for the
US Army Corps of Engineers, Walla Walla District
By Western Mine Engineering, Inc in cooperation
with Aventurine Engineering, Inc. 2003

October 2003

Ingersoll-Rand LM100A - percussion

Bit Life (feet/bit)

	Hole Diameter (inches)								
	1.75			2.00			2.50		
Granite	1,506	-	2,037	1,449	-	1,960	1,359	-	1,838
Basalt	674	-	912	649	-	878	608	-	823
Gabbro	1,002	-	1,356	964	-	1,305	904	-	1,223
Shale	1,427	-	1,931	1,373	-	1,858	1,287	-	1,742
Sandstone	524	-	709	504	-	682	473	-	639
Siltstone	3,779	-	5,112	3,636	-	4,919	3,409	-	4,612
Conglomer	292	-	395	281	-	380	263	-	356
Breccia	2,181	-	2,951	2,099	-	2,839	1,968	-	2,662
Limestone	1,835	-	2,483	1,766	-	2,389	1,656	-	2,240
Schist	3,414	-	4,619	3,285	-	4,444	3,080	-	4,167
Slate	1,710	-	2,313	1,645	-	2,226	1,542	-	2,087
Gneiss	735	-	995	707	-	957	663	-	897

Steel Life (feet/rod)

	Hole Diameter (inches)								
	1.75			2.00			2.50		
Granite	2,720	-	3,680	2,617	-	3,541	2,454	-	3,320
Basalt	1,417	-	1,918	1,364	-	1,845	1,279	-	1,730
Gabbro	1,600	-	2,164	1,539	-	2,083	1,443	-	1,953
Shale	2,855	-	3,863	2,747	-	3,717	2,576	-	3,485
Sandstone	2,978	-	4,029	2,865	-	3,877	2,687	-	3,635
Siltstone	2,964	-	4,011	2,852	-	3,859	2,674	-	3,618
Conglomer	3,425	-	4,633	3,295	-	4,458	3,090	-	4,180
Breccia	4,739	-	6,412	4,560	-	6,170	4,276	-	5,785
Limestone	3,931	-	5,318	3,782	-	5,117	3,546	-	4,798
Schist	4,828	-	6,532	4,646	-	6,285	4,356	-	5,893
Slate	3,133	-	4,239	3,015	-	4,079	2,827	-	3,824
Gneiss	2,849	-	3,855	2,742	-	3,709	2,571	-	3,478

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	1.75			2.00			2.50		
Granite	98	-	132	83	-	113	64	-	86
Basalt	57	-	77	48	-	65	37	-	50
Gabbro	63	-	85	53	-	72	41	-	55
Shale	102	-	138	87	-	117	66	-	90
Sandstone	105	-	142	90	-	121	69	-	93
Siltstone	105	-	142	89	-	121	68	-	92
Conglomer	118	-	160	101	-	136	77	-	104
Breccia	155	-	210	132	-	179	101	-	137
Limestone	133	-	180	113	-	153	86	-	117
Schist	158	-	213	134	-	181	103	-	139
Slate	110	-	149	94	-	127	72	-	97
Gneiss	102	-	137	86	-	117	66	-	89

	1.75 inch	2.00 inch	2.50 inch
3,000 lbs.	1,247 psi	955 psi	611 psi

Ingersoll-Rand LM100A - percussion

Bit Cost ($/foot)

	Hole Diameter (inches)								
	1.75			2.00			2.50		
Granite	$0.04	-	$0.03	$0.05	-	$0.03	$0.07	-	$0.05
Basalt	$0.09	-	$0.07	$0.10	-	$0.08	$0.15	-	$0.11
Gabbro	$0.06	-	$0.04	$0.07	-	$0.05	$0.10	-	$0.08
Shale	$0.04	-	$0.03	$0.05	-	$0.04	$0.07	-	$0.05
Sandstone	$0.11	-	$0.08	$0.13	-	$0.10	$0.20	-	$0.15
Siltstone	$0.02	-	$0.01	$0.02	-	$0.01	$0.03	-	$0.02
Conglomer	$0.21	-	$0.15	$0.24	-	$0.17	$0.36	-	$0.26
Breccia	$0.03	-	$0.02	$0.03	-	$0.02	$0.05	-	$0.04
Limestone	$0.03	-	$0.02	$0.04	-	$0.03	$0.06	-	$0.04
Schist	$0.02	-	$0.01	$0.02	-	$0.01	$0.03	-	$0.02
Slate	$0.04	-	$0.03	$0.04	-	$0.03	$0.06	-	$0.05
Gneiss	$0.08	-	$0.06	$0.09	-	$0.07	$0.14	-	$0.10

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	1.75			2.00			2.50		
Granite	$0.056	-	$0.042	$0.058	-	$0.043	$0.062	-	$0.046
Basalt	$0.108	-	$0.080	$0.112	-	$0.083	$0.120	-	$0.088
Gabbro	$0.096	-	$0.071	$0.099	-	$0.073	$0.106	-	$0.078
Shale	$0.054	-	$0.040	$0.056	-	$0.041	$0.059	-	$0.044
Sandstone	$0.051	-	$0.038	$0.053	-	$0.039	$0.057	-	$0.042
Siltstone	$0.052	-	$0.038	$0.054	-	$0.040	$0.057	-	$0.042
Conglomer	$0.045	-	$0.033	$0.046	-	$0.034	$0.050	-	$0.037
Breccia	$0.032	-	$0.024	$0.034	-	$0.025	$0.036	-	$0.026
Limestone	$0.039	-	$0.029	$0.040	-	$0.030	$0.043	-	$0.032
Schist	$0.032	-	$0.023	$0.033	-	$0.024	$0.035	-	$0.026
Slate	$0.049	-	$0.036	$0.051	-	$0.038	$0.054	-	$0.040
Gneiss	$0.054	-	$0.040	$0.056	-	$0.041	$0.060	-	$0.044

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	1.75 inch	2.00 inch	2.50
3,000 lbs.	1,247 psi	955 psi	611

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand ECM350 - percussion

Bit Life (feet/bit)

	Hole Diameter (inches)								
	2.50			3.00			4.00		
Granite	1,203	-	1,628	1,115	-	1,509	1,050	-	1,421
Basalt	539	-	729	499	-	676	470	-	636
Gabbro	801	-	1,083	742	-	1,004	699	-	946
Shale	1,140	-	1,542	1,057	-	1,430	995	-	1,347
Sandstone	418	-	566	388	-	525	365	-	494
Siltstone	3,019	-	4,084	2,798	-	3,786	2,636	-	3,566
Conglomer	233	-	315	216	-	292	204	-	275
Breccia	1,742	-	2,357	1,615	-	2,186	1,521	-	2,058
Limestone	1,466	-	1,983	1,359	-	1,839	1,280	-	1,732
Schist	2,727	-	3,690	2,528	-	3,421	2,381	-	3,222
Slate	1,366	-	1,848	1,266	-	1,713	1,193	-	1,613
Gneiss	587	-	795	544	-	737	513	-	694

Steel Life (feet/rod)

	Hole Diameter (inches)								
	2.50			3.00			4.00		
Granite	2,173	-	2,940	2,014	-	2,725	1,897	-	2,567
Basalt	1,132	-	1,532	1,050	-	1,420	989	-	1,338
Gabbro	1,278	-	1,729	1,185	-	1,603	1,116	-	1,510
Shale	2,281	-	3,086	2,115	-	2,861	1,992	-	2,695
Sandstone	2,379	-	3,218	2,205	-	2,984	2,077	-	2,810
Siltstone	2,368	-	3,204	2,195	-	2,970	2,068	-	2,798
Conglomer	2,736	-	3,701	2,536	-	3,431	2,389	-	3,232
Breccia	3,786	-	5,122	3,510	-	4,749	3,306	-	4,473
Limestone	3,140	-	4,249	2,911	-	3,939	2,742	-	3,710
Schist	3,857	-	5,218	3,576	-	4,838	3,368	-	4,556
Slate	2,503	-	3,386	2,320	-	3,139	2,185	-	2,957
Gneiss	2,276	-	3,080	2,110	-	2,855	1,987	-	2,689

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	2.50			3.00			4.00		
Granite	87	-	117	63	-	85	49	-	67
Basalt	50	-	68	37	-	50	29	-	39
Gabbro	56	-	75	41	-	55	32	-	43
Shale	90	-	122	66	-	89	51	-	69
Sandstone	93	-	126	68	-	92	53	-	72
Siltstone	93	-	126	68	-	92	53	-	71
Conglomer	105	-	142	76	-	103	60	-	81
Breccia	137	-	186	100	-	136	78	-	106
Limestone	118	-	159	86	-	116	67	-	90
Schist	140	-	189	102	-	138	79	-	107
Slate	97	-	132	71	-	96	55	-	75
Gneiss	90	-	122	66	-	89	51	-	69

	2.50 inch	3.25 inch	4.00 inch
6,000 lbs.	1,222 psi	723 psi	477 psi

Ingersoll-Rand ECM350 - percussion

Bit Cost ($/foot)

	Hole Diameter (inches)								
	2.50			3.00			4.00		
Granite	$0.08	-	$0.06	$0.11	-	$0.08	$0.20	-	$0.15
Basalt	$0.17	-	$0.13	$0.25	-	$0.19	$0.46	-	$0.34
Gabbro	$0.12	-	$0.09	$0.17	-	$0.13	$0.31	-	$0.23
Shale	$0.08	-	$0.06	$0.12	-	$0.09	$0.21	-	$0.16
Sandstone	$0.22	-	$0.17	$0.32	-	$0.24	$0.59	-	$0.43
Siltstone	$0.03	-	$0.02	$0.05	-	$0.03	$0.08	-	$0.06
Conglomer	$0.40	-	$0.30	$0.58	-	$0.43	$1.05	-	$0.78
Breccia	$0.05	-	$0.04	$0.08	-	$0.06	$0.14	-	$0.10
Limestone	$0.06	-	$0.05	$0.09	-	$0.07	$0.17	-	$0.12
Schist	$0.03	-	$0.03	$0.05	-	$0.04	$0.09	-	$0.07
Slate	$0.07	-	$0.05	$0.10	-	$0.07	$0.18	-	$0.13
Gneiss	$0.16	-	$0.12	$0.23	-	$0.17	$0.42	-	$0.31

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	2.50			3.00			4.00		
Granite	$0.092	-	$0.068	$0.099	-	$0.073	$0.105	-	$0.078
Basalt	$0.176	-	$0.130	$0.190	-	$0.140	$0.201	-	$0.149
Gabbro	$0.156	-	$0.115	$0.168	-	$0.124	$0.178	-	$0.132
Shale	$0.087	-	$0.064	$0.094	-	$0.070	$0.100	-	$0.074
Sandstone	$0.084	-	$0.062	$0.090	-	$0.067	$0.096	-	$0.071
Siltstone	$0.084	-	$0.062	$0.091	-	$0.067	$0.096	-	$0.071
Conglomer	$0.073	-	$0.054	$0.078	-	$0.058	$0.083	-	$0.062
Breccia	$0.053	-	$0.039	$0.057	-	$0.042	$0.060	-	$0.044
Limestone	$0.063	-	$0.047	$0.068	-	$0.051	$0.073	-	$0.054
Schist	$0.052	-	$0.038	$0.056	-	$0.041	$0.059	-	$0.044
Slate	$0.080	-	$0.059	$0.086	-	$0.063	$0.091	-	$0.067
Gneiss	$0.087	-	$0.065	$0.094	-	$0.070	$0.100	-	$0.074

(Based on12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	2.50 inch	3.00 inch	4.00
6,000 lbs.	1,222 psi	849 psi	477

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand ECM590 - percussion

Bit Life (feet/bit)

	Hole Diameter (inches)								
	2.50			3.50			4.50		
Granite	1,168	-	1,580	1,060	-	1,434	986	-	1,334
Basalt	523	-	708	475	-	642	441	-	597
Gabbro	778	-	1,052	706	-	955	656	-	888
Shale	1,107	-	1,498	1,005	-	1,359	934	-	1,264
Sandstone	406	-	550	369	-	499	343	-	464
Siltstone	2,931	-	3,966	2,660	-	3,599	2,474	-	3,347
Conglomer	226	-	306	205	-	278	191	-	259
Breccia	1,692	-	2,289	1,535	-	2,077	1,428	-	1,932
Limestone	1,424	-	1,926	1,292	-	1,748	1,201	-	1,626
Schist	2,648	-	3,583	2,403	-	3,251	2,235	-	3,024
Slate	1,326	-	1,794	1,203	-	1,628	1,119	-	1,514
Gneiss	570	-	771	517	-	700	481	-	651

Steel Life (feet/rod)

	Hole Diameter (inches)								
	2.50			3.50			4.50		
Granite	2,110	-	2,855	1,915	-	2,590	1,781	-	2,409
Basalt	1,100	-	1,488	998	-	1,350	928	-	1,255
Gabbro	1,241	-	1,679	1,126	-	1,524	1,047	-	1,417
Shale	2,215	-	2,997	2,010	-	2,719	1,869	-	2,529
Sandstone	2,310	-	3,125	2,096	-	2,836	1,950	-	2,638
Siltstone	2,300	-	3,111	2,087	-	2,823	1,941	-	2,626
Conglomer	2,657	-	3,594	2,411	-	3,262	2,242	-	3,033
Breccia	3,676	-	4,974	3,336	-	4,514	3,103	-	4,198
Limestone	3,049	-	4,125	2,767	-	3,744	2,573	-	3,482
Schist	3,745	-	5,067	3,399	-	4,598	3,161	-	4,277
Slate	2,430	-	3,288	2,205	-	2,984	2,051	-	2,775
Gneiss	2,210	-	2,990	2,006	-	2,714	1,865	-	2,524

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	2.50			3.50			4.50		
Granite	99	-	134	66	-	89	49	-	66
Basalt	57	-	78	38	-	52	28	-	38
Gabbro	63	-	86	42	-	57	31	-	42
Shale	103	-	139	69	-	93	51	-	69
Sandstone	107	-	144	71	-	96	52	-	71
Siltstone	106	-	144	71	-	96	52	-	71
Conglomer	120	-	162	80	-	108	59	-	80
Breccia	157	-	212	105	-	142	77	-	105
Limestone	134	-	182	90	-	121	66	-	90
Schist	159	-	216	106	-	144	79	-	106
Slate	111	-	150	74	-	100	55	-	74
Gneiss	103	-	139	68	-	93	51	-	68

	2.50 inch	3.50 inch	4.50 inch
5,500 lbs.	1,120 psi	572 psi	346 psi

Ingersoll-Rand ECM590 - percussion

Bit Cost ($/foot)

	Hole Diameter (inches)								
	2.50			3.50			4.50		
Granite	$0.08	-	$0.06	$0.14	-	$0.11	$0.26	-	$0.19
Basalt	$0.18	-	$0.13	$0.32	-	$0.24	$0.58	-	$0.43
Gabbro	$0.12	-	$0.09	$0.22	-	$0.16	$0.39	-	$0.29
Shale	$0.08	-	$0.06	$0.15	-	$0.11	$0.28	-	$0.20
Sandstone	$0.23	-	$0.17	$0.41	-	$0.31	$0.75	-	$0.56
Siltstone	$0.03	-	$0.02	$0.06	-	$0.04	$0.10	-	$0.08
Conglomer	$0.42	-	$0.31	$0.74	-	$0.55	$1.35	-	$1.00
Breccia	$0.06	-	$0.04	$0.10	-	$0.07	$0.18	-	$0.13
Limestone	$0.07	-	$0.05	$0.12	-	$0.09	$0.21	-	$0.16
Schist	$0.04	-	$0.03	$0.06	-	$0.05	$0.12	-	$0.09
Slate	$0.07	-	$0.05	$0.13	-	$0.09	$0.23	-	$0.17
Gneiss	$0.16	-	$0.12	$0.30	-	$0.22	$0.54	-	$0.40

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	2.50			3.50			4.50		
Granite	$0.094	-	$0.070	$0.104	-	$0.077	$0.112	-	$0.083
Basalt	$0.181	-	$0.134	$0.199	-	$0.147	$0.214	-	$0.159
Gabbro	$0.160	-	$0.119	$0.177	-	$0.131	$0.190	-	$0.140
Shale	$0.090	-	$0.066	$0.099	-	$0.073	$0.106	-	$0.079
Sandstone	$0.086	-	$0.064	$0.095	-	$0.070	$0.102	-	$0.075
Siltstone	$0.087	-	$0.064	$0.095	-	$0.070	$0.103	-	$0.076
Conglomer	$0.075	-	$0.055	$0.083	-	$0.061	$0.089	-	$0.066
Breccia	$0.054	-	$0.040	$0.060	-	$0.044	$0.064	-	$0.047
Limestone	$0.065	-	$0.048	$0.072	-	$0.053	$0.077	-	$0.057
Schist	$0.053	-	$0.039	$0.059	-	$0.043	$0.063	-	$0.047
Slate	$0.082	-	$0.061	$0.090	-	$0.067	$0.097	-	$0.072
Gneiss	$0.090	-	$0.067	$0.099	-	$0.073	$0.107	-	$0.079

(Based pm 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	2.50 inch	3.50 inch	4.50
5,500 lbs.	1,120 psi	572 psi	346

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand ECM720 - percussion

Bit Life (feet/bit)

	Hole Diameter (inches)								
	4.00			4.50			5.00		
Granite	2,305	-	3,118	2,228	-	3,014	2,161	-	2,924
Basalt	1,032	-	1,396	997	-	1,349	967	-	1,309
Gabbro	1,534	-	2,075	1,483	-	2,006	1,438	-	1,946
Shale	2,184	-	2,955	2,111	-	2,856	2,048	-	2,771
Sandstone	802	-	1,085	775	-	1,048	752	-	1,017
Siltstone	5,783	-	7,824	5,589	-	7,562	5,422	-	7,336
Conglomer	447	-	604	432	-	584	419	-	567
Breccia	3,338	-	4,516	3,227	-	4,365	3,130	-	4,235
Limestone	2,809	-	3,800	2,715	-	3,673	2,633	-	3,563
Schist	5,225	-	7,069	5,050	-	6,833	4,899	-	6,628
Slate	2,617	-	3,540	2,529	-	3,422	2,453	-	3,319
Gneiss	1,125	-	1,522	1,087	-	1,471	1,055	-	1,427

Steel Life (feet/rod)

	Hole Diameter (inches)								
	4.00			4.50			5.00		
Granite	4,163	-	5,632	4,024	-	5,444	3,903	-	5,281
Basalt	2,169	-	2,935	2,097	-	2,837	2,034	-	2,752
Gabbro	2,448	-	3,313	2,367	-	3,202	2,296	-	3,106
Shale	4,370	-	5,912	4,224	-	5,715	4,097	-	5,544
Sandstone	4,557	-	6,166	4,405	-	5,960	4,273	-	5,781
Siltstone	4,537	-	6,138	4,385	-	5,933	4,254	-	5,755
Conglomer	5,241	-	7,091	5,066	-	6,854	4,914	-	6,649
Breccia	7,253	-	9,813	7,011	-	9,485	6,801	-	9,201
Limestone	6,016	-	8,139	5,815	-	7,867	5,641	-	7,631
Schist	7,389	-	9,997	7,142	-	9,663	6,928	-	9,374
Slate	4,795	-	6,487	4,635	-	6,270	4,496	-	6,083
Gneiss	4,361	-	5,900	4,215	-	5,702	4,089	-	5,532

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	4.00			4.50			5.00		
Granite	100	-	135	87	-	117	76	-	103
Basalt	58	-	78	50	-	68	44	-	60
Gabbro	64	-	87	56	-	75	49	-	66
Shale	104	-	141	90	-	122	79	-	107
Sandstone	108	-	146	93	-	126	82	-	111
Siltstone	107	-	145	93	-	126	82	-	111
Conglomer	121	-	163	105	-	142	92	-	125
Breccia	158	-	214	137	-	186	121	-	164
Limestone	136	-	183	118	-	159	104	-	140
Schist	161	-	218	140	-	189	123	-	166
Slate	112	-	152	97	-	132	86	-	116
Gneiss	104	-	140	90	-	122	79	-	107

	4 inch	5 inch	5 inch
20,000 lbs.	1,592 psi	1,258 psi	1,019 psi

Ingersoll-Rand ECM720 - percussion

Bit Cost ($/foot)

	Hole Diameter (inches)								
	4.00			4.50			5.00		
Granite	$0.09	-	$0.07	$0.12	-	$0.09	$0.14	-	$0.11
Basalt	$0.21	-	$0.15	$0.26	-	$0.19	$0.32	-	$0.24
Gabbro	$0.14	-	$0.10	$0.17	-	$0.13	$0.21	-	$0.16
Shale	$0.10	-	$0.07	$0.12	-	$0.09	$0.15	-	$0.11
Sandstone	$0.27	-	$0.20	$0.33	-	$0.25	$0.41	-	$0.30
Siltstone	$0.04	-	$0.03	$0.05	-	$0.03	$0.06	-	$0.04
Conglomer	$0.48	-	$0.35	$0.60	-	$0.44	$0.74	-	$0.55
Breccia	$0.06	-	$0.05	$0.08	-	$0.06	$0.10	-	$0.07
Limestone	$0.08	-	$0.06	$0.10	-	$0.07	$0.12	-	$0.09
Schist	$0.04	-	$0.03	$0.05	-	$0.04	$0.06	-	$0.05
Slate	$0.08	-	$0.06	$0.10	-	$0.08	$0.13	-	$0.09
Gneiss	$0.19	-	$0.14	$0.24	-	$0.18	$0.29	-	$0.22

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	4.00			4.50			5.00		
Granite	$0.067	-	$0.050	$0.070	-	$0.051	$0.072	-	$0.053
Basalt	$0.129	-	$0.095	$0.134	-	$0.099	$0.138	-	$0.102
Gabbro	$0.114	-	$0.085	$0.118	-	$0.087	$0.122	-	$0.090
Shale	$0.064	-	$0.047	$0.066	-	$0.049	$0.068	-	$0.051
Sandstone	$0.061	-	$0.045	$0.064	-	$0.047	$0.066	-	$0.048
Siltstone	$0.062	-	$0.046	$0.064	-	$0.047	$0.066	-	$0.049
Conglomer	$0.053	-	$0.039	$0.055	-	$0.041	$0.057	-	$0.042
Breccia	$0.039	-	$0.029	$0.040	-	$0.030	$0.041	-	$0.030
Limestone	$0.047	-	$0.034	$0.048	-	$0.036	$0.050	-	$0.037
Schist	$0.038	-	$0.028	$0.039	-	$0.029	$0.040	-	$0.030
Slate	$0.058	-	$0.043	$0.060	-	$0.045	$0.062	-	$0.046
Gneiss	$0.064	-	$0.047	$0.066	-	$0.049	$0.068	-	$0.051

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	4 inch	4.5 inch	5
20,000 lbs.	1,592 psi	1,258 psi	1,019

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM25SP - DTH

Bit Life (feet/bit)

	Hole Diameter (inches)								
	3.50			5.00			6.50		
Granite	2,498	-	3,380	2,254	-	3,049	2,089	-	2,827
Basalt	1,118	-	1,513	1,009	-	1,365	935	-	1,266
Gabbro	1,663	-	2,250	1,500	-	2,030	1,391	-	1,882
Shale	2,367	-	3,203	2,136	-	2,890	1,980	-	2,679
Sandstone	869	-	1,176	784	-	1,061	727	-	983
Siltstone	6,268	-	8,481	5,655	-	7,651	5,243	-	7,093
Conglome	484	-	655	437	-	591	405	-	548
Breccia	3,618	-	4,896	3,265	-	4,417	3,026	-	4,095
Limestone	3,044	-	4,119	2,747	-	3,716	2,546	-	3,445
Schist	5,664	-	7,663	5,110	-	6,913	4,737	-	6,409
Slate	2,836	-	3,837	2,559	-	3,462	2,372	-	3,209
Gneiss	1,219	-	1,650	1,100	-	1,489	1,020	-	1,380

Steel Life (feet/rod)

	Hole Diameter (inches)								
	3.50			5.00			6.50		
Granite	28,996	-	39,229	26,159	-	35,392	24,252	-	32,811
Basalt	16,978	-	22,970	15,317	-	20,723	14,200	-	19,212
Gabbro	18,752	-	25,371	16,918	-	22,889	15,684	-	21,220
Shale	30,177	-	40,827	27,225	-	36,834	25,240	-	34,148
Sandstone	31,235	-	42,259	28,180	-	38,125	26,125	-	35,345
Siltstone	31,120	-	42,103	28,076	-	37,985	26,028	-	35,215
Conglome	35,035	-	47,400	31,608	-	42,764	29,303	-	39,645
Breccia	45,750	-	61,896	41,275	-	55,842	38,265	-	51,770
Limestone	39,235	-	53,082	35,397	-	47,890	32,816	-	44,398
Schist	46,452	-	62,847	41,908	-	56,699	38,852	-	52,565
Slate	32,566	-	44,060	29,381	-	39,750	27,238	-	36,852
Gneiss	30,123	-	40,755	27,177	-	36,768	25,195	-	34,087

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	3.50			5.00			6.50		
Granite	129	-	175	84	-	114	61	-	83
Basalt	75	-	102	49	-	66	36	-	48
Gabbro	83	-	113	54	-	73	39	-	53
Shale	135	-	182	88	-	119	64	-	87
Sandstone	140	-	189	91	-	123	66	-	90
Siltstone	139	-	188	90	-	122	66	-	89
Conglome	157	-	212	102	-	138	74	-	101
Breccia	205	-	278	134	-	181	98	-	132
Limestone	176	-	238	114	-	155	83	-	113
Schist	209	-	282	136	-	184	99	-	134
Slate	146	-	197	95	-	128	69	-	93
Gneiss	134	-	182	88	-	118	64	-	86

	3.50 inch	5.00 inch	6.50 inch
25,000 lbs.	2,598 psi	1,273 psi	753 psi

Ingersoll-Rand DM25SP - DTH

Bit Cost ($/foot)

	Hole Diameter (inches)								
	3.50			5.00			6.50		
Granite	$0.16	-	$0.12	$0.24	-	$0.18	$0.32	-	$0.24
Basalt	$0.37	-	$0.27	$0.55	-	$0.40	$0.72	-	$0.53
Gabbro	$0.25	-	$0.18	$0.37	-	$0.27	$0.49	-	$0.36
Shale	$0.17	-	$0.13	$0.26	-	$0.19	$0.34	-	$0.25
Sandstone	$0.47	-	$0.35	$0.70	-	$0.52	$0.93	-	$0.69
Siltstone	$0.07	-	$0.05	$0.10	-	$0.07	$0.13	-	$0.10
Conglome	$0.85	-	$0.63	$1.26	-	$0.93	$1.67	-	$1.23
Breccia	$0.11	-	$0.08	$0.17	-	$0.12	$0.22	-	$0.16
Limestone	$0.13	-	$0.10	$0.20	-	$0.15	$0.27	-	$0.20
Schist	$0.07	-	$0.05	$0.11	-	$0.08	$0.14	-	$0.11
Slate	$0.14	-	$0.11	$0.21	-	$0.16	$0.28	-	$0.21
Gneiss	$0.34	-	$0.25	$0.50	-	$0.37	$0.66	-	$0.49

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	3.50			5.00			6.50		
Granite	$0.009	-	$0.007	$0.011	-	$0.008	$0.024	-	$0.018
Basalt	$0.016	-	$0.012	$0.018	-	$0.014	$0.041	-	$0.031
Gabbro	$0.014	-	$0.011	$0.017	-	$0.012	$0.037	-	$0.028
Shale	$0.009	-	$0.007	$0.010	-	$0.008	$0.023	-	$0.017
Sandstone	$0.009	-	$0.006	$0.010	-	$0.007	$0.022	-	$0.017
Siltstone	$0.009	-	$0.006	$0.010	-	$0.007	$0.023	-	$0.017
Conglome	$0.008	-	$0.006	$0.009	-	$0.007	$0.020	-	$0.015
Breccia	$0.006	-	$0.004	$0.007	-	$0.005	$0.015	-	$0.011
Limestone	$0.007	-	$0.005	$0.008	-	$0.006	$0.018	-	$0.013
Schist	$0.006	-	$0.004	$0.007	-	$0.005	$0.015	-	$0.011
Slate	$0.008	-	$0.006	$0.010	-	$0.007	$0.022	-	$0.016
Gneiss	$0.009	-	$0.007	$0.010	-	$0.008	$0.023	-	$0.017

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	3.50 inch	5.00 inch	6.50
25,000 lbs.	2,598 psi	1,273 psi	753

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM30 -DTH

Bit Life (feet/bit)

	Hole Diameter (inches)								
	5.50			6.00			6.50		
Granite	1,946	-	2,633	1,898	-	2,568	1,855	-	2,509
Basalt	871	-	1,179	850	-	1,150	830	-	1,124
Gabbro	1,296	-	1,753	1,263	-	1,709	1,235	-	1,670
Shale	1,845	-	2,496	1,799	-	2,434	1,758	-	2,378
Sandstone	677	-	916	660	-	893	645	-	873
Siltstone	4,884	-	6,608	4,763	-	6,444	4,654	-	6,297
Conglome	377	-	510	368	-	498	360	-	486
Breccia	2,819	-	3,814	2,749	-	3,720	2,687	-	3,635
Limestone	2,372	-	3,209	2,313	-	3,130	2,260	-	3,058
Schist	4,413	-	5,970	4,303	-	5,822	4,205	-	5,689
Slate	2,210	-	2,990	2,155	-	2,916	2,106	-	2,849
Gneiss	950	-	1,285	927	-	1,254	905	-	1,225

Steel Life (feet/rod)

	Hole Diameter (inches)								
	5.50			6.00			6.50		
Granite	26,110	-	35,326	25,463	-	34,450	24,881	-	33,663
Basalt	15,288	-	20,684	14,909	-	20,171	14,569	-	19,711
Gabbro	16,886	-	22,846	16,468	-	22,280	16,092	-	21,771
Shale	27,174	-	36,765	26,500	-	35,853	25,895	-	35,034
Sandstone	28,127	-	38,054	27,429	-	37,110	26,803	-	36,263
Siltstone	28,023	-	37,914	27,328	-	36,974	26,704	-	36,129
Conglome	31,549	-	42,684	30,766	-	41,625	30,064	-	40,675
Breccia	41,197	-	55,738	40,176	-	54,355	39,258	-	53,114
Limestone	35,331	-	47,800	34,455	-	46,615	33,668	-	45,551
Schist	41,830	-	56,593	40,792	-	55,190	39,861	-	53,929
Slate	29,326	-	39,676	28,599	-	38,692	27,945	-	37,809
Gneiss	27,126	-	36,700	26,453	-	35,790	25,849	-	34,972

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	5.50			6.00			6.50		
Granite	81	-	110	73	-	99	67	-	90
Basalt	47	-	64	43	-	58	39	-	52
Gabbro	52	-	71	47	-	64	43	-	58
Shale	85	-	115	76	-	103	69	-	94
Sandstone	88	-	119	79	-	107	72	-	97
Siltstone	87	-	118	79	-	107	72	-	97
Conglome	99	-	133	89	-	120	81	-	109
Breccia	129	-	175	116	-	158	106	-	143
Limestone	111	-	150	100	-	135	91	-	122
Schist	131	-	178	118	-	160	107	-	145
Slate	92	-	124	83	-	112	75	-	101
Gneiss	85	-	115	76	-	103	69	-	94

	5.50 inch	6.00 inch	6.50 inch
30,000 lbs.	1,263 psi	1,061 psi	904 psi

Ingersoll-Rand DM30 -DTH

Bit Cost ($/foot)

	Hole Diameter (inches)								
	5.50			6.00			6.50		
Granite	$0.30	-	$0.22	$0.33	-	$0.25	$0.36	-	$0.27
Basalt	$0.66	-	$0.49	$0.74	-	$0.55	$0.81	-	$0.60
Gabbro	$0.44	-	$0.33	$0.50	-	$0.37	$0.55	-	$0.40
Shale	$0.31	-	$0.23	$0.35	-	$0.26	$0.38	-	$0.28
Sandstone	$0.85	-	$0.63	$0.95	-	$0.71	$1.05	-	$0.77
Siltstone	$0.12	-	$0.09	$0.13	-	$0.10	$0.15	-	$0.11
Conglome	$1.52	-	$1.13	$1.71	-	$1.27	$1.88	-	$1.39
Breccia	$0.20	-	$0.15	$0.23	-	$0.17	$0.25	-	$0.19
Limestone	$0.24	-	$0.18	$0.27	-	$0.20	$0.30	-	$0.22
Schist	$0.13	-	$0.10	$0.15	-	$0.11	$0.16	-	$0.12
Slate	$0.26	-	$0.19	$0.29	-	$0.22	$0.32	-	$0.24
Gneiss	$0.61	-	$0.45	$0.68	-	$0.50	$0.75	-	$0.55

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	5.50			6.00			6.50		
Granite	$0.022	-	$0.017	$0.023	-	$0.017	$0.024	-	$0.017
Basalt	$0.038	-	$0.028	$0.039	-	$0.029	$0.040	-	$0.030
Gabbro	$0.035	-	$0.026	$0.036	-	$0.026	$0.036	-	$0.027
Shale	$0.022	-	$0.016	$0.022	-	$0.016	$0.023	-	$0.017
Sandstone	$0.021	-	$0.015	$0.021	-	$0.016	$0.022	-	$0.016
Siltstone	$0.021	-	$0.015	$0.021	-	$0.016	$0.022	-	$0.016
Conglome	$0.019	-	$0.014	$0.019	-	$0.014	$0.019	-	$0.014
Breccia	$0.014	-	$0.011	$0.015	-	$0.011	$0.015	-	$0.011
Limestone	$0.017	-	$0.012	$0.017	-	$0.013	$0.017	-	$0.013
Schist	$0.014	-	$0.010	$0.014	-	$0.011	$0.015	-	$0.011
Slate	$0.020	-	$0.015	$0.020	-	$0.015	$0.021	-	$0.015
Gneiss	$0.022	-	$0.016	$0.022	-	$0.016	$0.023	-	$0.017

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	5.50 inch	6.00 inch	6.50
30,000 lbs.	1,263 psi	1,061 psi	904

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM45 -DTH

Bit Life (feet/bit)

	Hole Diameter (inches)								
	5.00			6.50			8.00		
Granite	2,580	-	3,490	2,392	-	3,236	2,253	-	3,048
Basalt	1,155	-	1,563	1,071	-	1,449	1,009	-	1,364
Gabbro	1,717	-	2,323	1,592	-	2,154	1,499	-	2,029
Shale	2,445	-	3,308	2,267	-	3,067	2,135	-	2,888
Sandstone	897	-	1,214	832	-	1,126	784	-	1,060
Siltstone	6,473	-	8,758	6,001	-	8,120	5,652	-	7,647
Conglomer	500	-	677	464	-	627	437	-	591
Breccia	3,737	-	5,056	3,464	-	4,687	3,263	-	4,414
Limestone	3,144	-	4,254	2,915	-	3,944	2,745	-	3,714
Schist	5,849	-	7,913	5,422	-	7,336	5,107	-	6,910
Slate	2,929	-	3,963	2,715	-	3,674	2,557	-	3,460
Gneiss	1,259	-	1,704	1,168	-	1,580	1,100	-	1,488

Steel Life (feet/rod)

	Hole Diameter (inches)								
	5.00			6.50			8.00		
Granite	28,482	-	38,534	26,405	-	35,724	24,869	-	33,646
Basalt	16,677	-	22,563	15,461	-	20,917	14,561	-	19,701
Gabbro	18,420	-	24,921	17,077	-	23,104	16,083	-	21,760
Shale	29,642	-	40,104	27,480	-	37,179	25,882	-	35,017
Sandstone	30,681	-	41,510	28,444	-	38,483	26,789	-	36,245
Siltstone	30,568	-	41,357	28,339	-	38,341	26,691	-	36,111
Conglomer	34,414	-	46,560	31,904	-	43,165	30,049	-	40,654
Breccia	44,939	-	60,799	41,662	-	56,366	39,238	-	53,087
Limestone	38,539	-	52,141	35,729	-	48,339	33,651	-	45,527
Schist	45,628	-	61,733	42,301	-	57,231	39,841	-	53,902
Slate	31,989	-	43,279	29,656	-	40,123	27,931	-	37,789
Gneiss	29,589	-	40,032	27,432	-	37,113	25,836	-	34,955

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	5.00			6.50			8.00		
Granite	109	-	148	80	-	108	62	-	84
Basalt	64	-	86	46	-	63	36	-	49
Gabbro	70	-	95	51	-	69	40	-	54
Shale	114	-	154	83	-	112	65	-	88
Sandstone	118	-	160	86	-	116	67	-	91
Siltstone	118	-	159	86	-	116	67	-	90
Conglomer	133	-	179	97	-	131	75	-	102
Breccia	174	-	235	127	-	171	99	-	134
Limestone	149	-	201	108	-	147	84	-	114
Schist	177	-	239	129	-	174	100	-	136
Slate	123	-	167	90	-	121	70	-	95
Gneiss	114	-	154	83	-	112	65	-	87

	5.00 inch	6.50 inch	8.00 inch
45,000 lbs.	2,292 psi	1,356 psi	895 psi

Ingersoll-Rand DM45 -DTH

Bit Cost ($/foot)

	Hole Diameter (inches)								
	5.00			6.50			8.00		
Granite	$0.21	-	$0.16	$0.28	-	$0.21	$0.47	-	$0.35
Basalt	$0.48	-	$0.35	$0.63	-	$0.47	$1.04	-	$0.77
Gabbro	$0.32	-	$0.24	$0.42	-	$0.31	$0.70	-	$0.52
Shale	$0.22	-	$0.17	$0.30	-	$0.22	$0.49	-	$0.36
Sandstone	$0.61	-	$0.45	$0.81	-	$0.60	$1.34	-	$0.99
Siltstone	$0.08	-	$0.06	$0.11	-	$0.08	$0.19	-	$0.14
Conglomer	$1.10	-	$0.81	$1.46	-	$1.08	$2.41	-	$1.78
Breccia	$0.15	-	$0.11	$0.19	-	$0.14	$0.32	-	$0.24
Limestone	$0.17	-	$0.13	$0.23	-	$0.17	$0.38	-	$0.28
Schist	$0.09	-	$0.07	$0.12	-	$0.09	$0.21	-	$0.15
Slate	$0.19	-	$0.14	$0.25	-	$0.18	$0.41	-	$0.30
Gneiss	$0.44	-	$0.32	$0.58	-	$0.43	$0.96	-	$0.71

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	5.00			6.50			8.00		
Granite	$0.021	-	$0.015	$0.023	-	$0.017	$0.029	-	$0.021
Basalt	$0.035	-	$0.026	$0.039	-	$0.029	$0.049	-	$0.037
Gabbro	$0.032	-	$0.024	$0.036	-	$0.026	$0.045	-	$0.033
Shale	$0.020	-	$0.015	$0.022	-	$0.016	$0.028	-	$0.021
Sandstone	$0.019	-	$0.014	$0.021	-	$0.016	$0.027	-	$0.020
Siltstone	$0.019	-	$0.014	$0.022	-	$0.016	$0.027	-	$0.020
Conglomer	$0.017	-	$0.013	$0.019	-	$0.014	$0.024	-	$0.018
Breccia	$0.013	-	$0.010	$0.015	-	$0.011	$0.018	-	$0.014
Limestone	$0.015	-	$0.011	$0.017	-	$0.013	$0.021	-	$0.016
Schist	$0.013	-	$0.009	$0.014	-	$0.011	$0.018	-	$0.013
Slate	$0.018	-	$0.014	$0.021	-	$0.015	$0.026	-	$0.019
Gneiss	$0.020	-	$0.015	$0.022	-	$0.016	$0.028	-	$0.021

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	5.00 inch	6.50 inch	8.00
45,000 lbs.	2,292 psi	1,356 psi	895

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM M2 -DTH

Bit Life (feet/bit)

	Hole Diameter (inches)								
	8.88			10.00			11.875		
Granite	1,779	-	2,407	1,719	-	2,325	1,636	-	2,213
Basalt	796	-	1,078	770	-	1,041	732	-	991
Gabbro	1,184	-	1,602	1,144	-	1,548	1,089	-	1,473
Shale	1,686	-	2,281	1,629	-	2,204	1,550	-	2,097
Sandstone	619	-	837	598	-	809	569	-	770
Siltstone	4,464	-	6,039	4,313	-	5,835	4,104	-	5,553
Conglomer	345	-	467	333	-	451	317	-	429
Breccia	2,577	-	3,486	2,490	-	3,368	2,369	-	3,205
Limestone	2,168	-	2,933	2,095	-	2,834	1,993	-	2,697
Schist	4,033	-	5,457	3,897	-	5,272	3,708	-	5,017
Slate	2,020	-	2,733	1,951	-	2,640	1,857	-	2,512
Gneiss	868	-	1,175	839	-	1,135	798	-	1,080

Steel Life (feet/rod)

	Hole Diameter (inches)								
	8.88			10.00			11.875		
Granite	25,947	-	35,105	25,069	-	33,917	23,856	-	32,276
Basalt	15,193	-	20,555	14,679	-	19,859	13,968	-	18,898
Gabbro	16,781	-	22,704	16,213	-	21,935	15,428	-	20,874
Shale	27,004	-	36,535	26,090	-	35,298	24,828	-	33,590
Sandstone	27,951	-	37,817	27,005	-	36,536	25,698	-	34,768
Siltstone	27,848	-	37,677	26,905	-	36,401	25,604	-	34,640
Conglomer	31,352	-	42,417	30,290	-	40,981	28,825	-	38,998
Breccia	40,940	-	55,390	39,554	-	53,514	37,640	-	50,925
Limestone	35,110	-	47,502	33,921	-	45,894	32,280	-	43,673
Schist	41,569	-	56,240	40,161	-	54,336	38,218	-	51,707
Slate	29,143	-	39,428	28,156	-	38,093	26,794	-	36,250
Gneiss	26,957	-	36,471	26,044	-	35,236	24,784	-	33,531

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	8.88			10.00			11.875		
Granite	69	-	93	60	-	81	48	-	66
Basalt	40	-	54	35	-	47	28	-	38
Gabbro	44	-	60	38	-	52	31	-	42
Shale	72	-	97	62	-	84	50	-	68
Sandstone	74	-	100	64	-	87	52	-	71
Siltstone	74	-	100	64	-	87	52	-	70
Conglomer	83	-	113	72	-	98	59	-	79
Breccia	109	-	148	95	-	128	77	-	104
Limestone	94	-	127	81	-	110	66	-	89
Schist	111	-	150	96	-	130	78	-	106
Slate	77	-	105	67	-	91	55	-	74
Gneiss	72	-	97	62	-	84	50	-	68

	8.88 inch	10.00 inch	11.88 inch
75,000 lbs.	1,212 psi	955 psi	677 psi

Ingersoll-Rand DM M2 -DTH

Bit Cost ($/foot)

	Hole Diameter (inches)								
	8.88			10.00			11.875		
Granite	$0.31	-	$0.23	$0.39	-	$0.29	$0.64	-	$0.48
Basalt	$0.69	-	$0.51	$0.88	-	$0.65	$1.44	-	$1.06
Gabbro	$0.46	-	$0.34	$0.59	-	$0.44	$0.97	-	$0.71
Shale	$0.33	-	$0.24	$0.41	-	$0.31	$0.68	-	$0.50
Sandstone	$0.89	-	$0.66	$1.13	-	$0.83	$1.85	-	$1.37
Siltstone	$0.12	-	$0.09	$0.16	-	$0.12	$0.26	-	$0.19
Conglomer	$1.60	-	$1.18	$2.03	-	$1.50	$3.32	-	$2.46
Breccia	$0.21	-	$0.16	$0.27	-	$0.20	$0.44	-	$0.33
Limestone	$0.25	-	$0.19	$0.32	-	$0.24	$0.53	-	$0.39
Schist	$0.14	-	$0.10	$0.17	-	$0.13	$0.28	-	$0.21
Slate	$0.27	-	$0.20	$0.35	-	$0.26	$0.57	-	$0.42
Gneiss	$0.63	-	$0.47	$0.80	-	$0.59	$1.32	-	$0.97

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	8.88			10.00			11.875		
Granite	$0.024	-	$0.017	$0.029	-	$0.021	$0.048	-	$0.035
Basalt	$0.040	-	$0.030	$0.049	-	$0.036	$0.082	-	$0.060
Gabbro	$0.036	-	$0.027	$0.044	-	$0.033	$0.074	-	$0.055
Shale	$0.023	-	$0.017	$0.028	-	$0.020	$0.046	-	$0.034
Sandstone	$0.022	-	$0.016	$0.027	-	$0.020	$0.044	-	$0.033
Siltstone	$0.022	-	$0.016	$0.027	-	$0.020	$0.045	-	$0.033
Conglomer	$0.019	-	$0.014	$0.024	-	$0.018	$0.040	-	$0.029
Breccia	$0.015	-	$0.011	$0.018	-	$0.013	$0.030	-	$0.022
Limestone	$0.017	-	$0.013	$0.021	-	$0.016	$0.035	-	$0.026
Schist	$0.015	-	$0.011	$0.018	-	$0.013	$0.030	-	$0.022
Slate	$0.021	-	$0.015	$0.026	-	$0.019	$0.043	-	$0.031
Gneiss	$0.023	-	$0.017	$0.028	-	$0.020	$0.046	-	$0.034

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	8.88 inch	10.00 inch	11.88
75,000 lbs.	1,212 psi	955 psi	677

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM25SP - Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	3.88			5.00			6.25		
Granite	3,585	-	4,851	3,364	-	4,552	3,182	-	4,305
Basalt	1,878	-	2,541	1,762	-	2,384	1,667	-	2,255
Gabbro	2,118	-	2,865	1,987	-	2,689	1,880	-	2,543
Shale	3,762	-	5,090	3,531	-	4,777	3,339	-	4,518
Sandstone	3,922	-	5,307	3,681	-	4,980	3,481	-	4,710
Siltstone	3,905	-	5,283	3,664	-	4,957	3,466	-	4,689
Conglomer	4,506	-	6,096	4,228	-	5,720	3,999	-	5,411
Breccia	6,220	-	8,415	5,836	-	7,896	5,520	-	7,468
Limestone	5,166	-	6,990	4,848	-	6,559	4,585	-	6,203
Schist	6,335	-	8,571	5,945	-	8,043	5,623	-	7,607
Slate	4,125	-	5,581	3,871	-	5,237	3,661	-	4,953
Gneiss	3,754	-	5,079	3,523	-	4,766	3,332	-	4,508

Steel Life (feet/rod)

	Hole Diameter (inches)								
	3.88			5.00			6.25		
Granite	44,519	-	60,232	41,775	-	56,519	39,512	-	53,457
Basalt	26,067	-	35,267	24,460	-	33,093	23,135	-	31,301
Gabbro	28,792	-	38,954	27,017	-	36,552	25,553	-	34,572
Shale	46,333	-	62,685	43,477	-	58,821	41,121	-	55,635
Sandstone	47,957	-	64,883	45,001	-	60,884	42,563	-	57,586
Siltstone	47,780	-	64,644	44,835	-	60,659	42,406	-	57,373
Conglomer	53,792	-	72,777	50,476	-	68,291	47,741	-	64,591
Breccia	70,243	-	95,034	65,913	-	89,176	62,342	-	84,345
Limestone	60,240	-	81,501	56,527	-	76,478	53,465	-	72,334
Schist	71,321	-	96,493	66,925	-	90,545	63,299	-	85,640
Slate	50,001	-	67,649	46,919	-	63,479	44,377	-	60,040
Gneiss	46,250	-	62,574	43,400	-	58,717	41,048	-	55,536

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	3.88			5.00			6.25		
Granite	57	-	77	34	-	46	22	-	29
Basalt	33	-	45	20	-	27	13	-	17
Gabbro	37	-	50	22	-	30	14	-	19
Shale	60	-	81	36	-	48	23	-	31
Sandstone	62	-	83	37	-	50	23	-	32
Siltstone	61	-	83	37	-	50	23	-	32
Conglomer	69	-	94	41	-	56	26	-	36
Breccia	91	-	123	54	-	73	34	-	47
Limestone	78	-	105	46	-	63	29	-	40
Schist	92	-	125	55	-	74	35	-	47
Slate	64	-	87	38	-	52	24	-	33
Gneiss	59	-	80	35	-	48	23	-	31

	3.88 inch	5.00 inch	6.25 inch
25,000 lbs.	2,120 psi	1,273 psi	815 psi

Ingersoll-Rand DM25SP - Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	3.88			5.00			6.25		
Granite	$0.28	-	$0.20	$0.42	-	$0.31	$0.60	-	$0.44
Basalt	$0.53	-	$0.39	$0.80	-	$0.59	$1.14	-	$0.85
Gabbro	$0.47	-	$0.35	$0.71	-	$0.52	$1.01	-	$0.75
Shale	$0.26	-	$0.20	$0.40	-	$0.29	$0.57	-	$0.42
Sandstone	$0.25	-	$0.19	$0.38	-	$0.28	$0.55	-	$0.40
Siltstone	$0.25	-	$0.19	$0.38	-	$0.28	$0.55	-	$0.41
Conglomer	$0.22	-	$0.16	$0.33	-	$0.25	$0.48	-	$0.35
Breccia	$0.16	-	$0.12	$0.24	-	$0.18	$0.35	-	$0.26
Limestone	$0.19	-	$0.14	$0.29	-	$0.21	$0.42	-	$0.31
Schist	$0.16	-	$0.12	$0.24	-	$0.17	$0.34	-	$0.25
Slate	$0.24	-	$0.18	$0.36	-	$0.27	$0.52	-	$0.38
Gneiss	$0.26	-	$0.20	$0.40	-	$0.30	$0.57	-	$0.42

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	3.88			5.00			6.25		
Granite	$0.006	-	$0.004	$0.007	-	$0.005	$0.015	-	$0.011
Basalt	$0.010	-	$0.008	$0.011	-	$0.008	$0.025	-	$0.019
Gabbro	$0.009	-	$0.007	$0.010	-	$0.008	$0.023	-	$0.017
Shale	$0.006	-	$0.004	$0.006	-	$0.005	$0.014	-	$0.011
Sandstone	$0.006	-	$0.004	$0.006	-	$0.005	$0.014	-	$0.010
Siltstone	$0.006	-	$0.004	$0.006	-	$0.005	$0.014	-	$0.010
Conglomer	$0.005	-	$0.004	$0.006	-	$0.004	$0.012	-	$0.009
Breccia	$0.004	-	$0.003	$0.004	-	$0.003	$0.009	-	$0.007
Limestone	$0.004	-	$0.003	$0.005	-	$0.004	$0.011	-	$0.008
Schist	$0.004	-	$0.003	$0.004	-	$0.003	$0.009	-	$0.007
Slate	$0.005	-	$0.004	$0.006	-	$0.004	$0.013	-	$0.010
Gneiss	$0.006	-	$0.004	$0.006	-	$0.005	$0.014	-	$0.011

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	3.88 inch	5.00 inch	6.25
25,000 lbs.	2,120 psi	1,273 psi	815

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM30 -Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	5.50			6.00			6.75		
Granite	3,347	-	4,528	3,275	-	4,431	3,180	-	4,302
Basalt	1,753	-	2,372	1,716	-	2,321	1,666	-	2,254
Gabbro	1,977	-	2,675	1,934	-	2,617	1,878	-	2,541
Shale	3,512	-	4,752	3,437	-	4,649	3,337	-	4,515
Sandstone	3,661	-	4,954	3,583	-	4,847	3,479	-	4,707
Siltstone	3,645	-	4,931	3,567	-	4,826	3,463	-	4,686
Conglomer	4,206	-	5,690	4,116	-	5,568	3,996	-	5,407
Breccia	5,806	-	7,855	5,681	-	7,686	5,516	-	7,463
Limestone	4,822	-	6,524	4,719	-	6,384	4,582	-	6,199
Schist	5,913	-	8,000	5,786	-	7,829	5,619	-	7,602
Slate	3,851	-	5,210	3,768	-	5,098	3,659	-	4,950
Gneiss	3,504	-	4,741	3,429	-	4,639	3,330	-	4,505

Steel Life (feet/rod)

	Hole Diameter (inches)								
	5.50			6.00			6.75		
Granite	41,556	-	56,222	40,663	-	55,014	39,485	-	53,421
Basalt	24,332	-	32,920	23,809	-	32,212	23,119	-	31,279
Gabbro	26,875	-	36,360	26,298	-	35,579	25,536	-	34,549
Shale	43,248	-	58,513	42,319	-	57,255	41,093	-	55,597
Sandstone	44,765	-	60,564	43,803	-	59,263	42,534	-	57,546
Siltstone	44,600	-	60,341	43,642	-	59,045	42,377	-	57,334
Conglomer	50,211	-	67,932	49,132	-	66,473	47,709	-	64,547
Breccia	65,567	-	88,708	64,158	-	86,802	62,299	-	84,288
Limestone	56,230	-	76,076	55,022	-	74,441	53,428	-	72,285
Schist	66,573	-	90,070	65,143	-	88,135	63,256	-	85,582
Slate	46,673	-	63,146	45,670	-	61,789	44,347	-	59,999
Gneiss	43,172	-	58,409	42,244	-	57,154	41,020	-	55,498

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	5.50			6.00			6.75		
Granite	32	-	43	27	-	36	21	-	28
Basalt	18	-	25	15	-	21	12	-	16
Gabbro	20	-	28	17	-	23	13	-	18
Shale	33	-	45	28	-	37	22	-	29
Sandstone	34	-	46	29	-	39	23	-	31
Siltstone	34	-	46	29	-	39	22	-	30
Conglomer	38	-	52	32	-	44	25	-	34
Breccia	50	-	68	42	-	57	33	-	45
Limestone	43	-	58	36	-	49	28	-	38
Schist	51	-	69	43	-	58	34	-	46
Slate	36	-	48	30	-	40	24	-	32
Gneiss	33	-	45	28	-	37	22	-	29

	5.50 inch	6 inch	6.75 inch
30,000 lbs.	1,263 psi	1,061 psi	838 psi

Ingersoll-Rand DM30 -Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	5.50			6.00			6.75		
Granite	$0.51	-	$0.38	$0.56	-	$0.42	$0.67	-	$0.49
Basalt	$0.97	-	$0.72	$1.07	-	$0.79	$1.28	-	$0.94
Gabbro	$0.86	-	$0.64	$0.95	-	$0.70	$1.13	-	$0.84
Shale	$0.48	-	$0.36	$0.54	-	$0.40	$0.64	-	$0.47
Sandstone	$0.47	-	$0.34	$0.51	-	$0.38	$0.61	-	$0.45
Siltstone	$0.47	-	$0.35	$0.52	-	$0.38	$0.61	-	$0.45
Conglomer	$0.40	-	$0.30	$0.45	-	$0.33	$0.53	-	$0.39
Breccia	$0.29	-	$0.22	$0.32	-	$0.24	$0.39	-	$0.29
Limestone	$0.35	-	$0.26	$0.39	-	$0.29	$0.46	-	$0.34
Schist	$0.29	-	$0.21	$0.32	-	$0.24	$0.38	-	$0.28
Slate	$0.44	-	$0.33	$0.49	-	$0.36	$0.58	-	$0.43
Gneiss	$0.49	-	$0.36	$0.54	-	$0.40	$0.64	-	$0.47

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	5.50			6.00			6.75		
Granite	$0.014	-	$0.010	$0.014	-	$0.011	$0.015	-	$0.011
Basalt	$0.024	-	$0.018	$0.025	-	$0.018	$0.025	-	$0.019
Gabbro	$0.022	-	$0.016	$0.022	-	$0.016	$0.023	-	$0.017
Shale	$0.014	-	$0.010	$0.014	-	$0.010	$0.014	-	$0.011
Sandstone	$0.013	-	$0.010	$0.013	-	$0.010	$0.014	-	$0.010
Siltstone	$0.013	-	$0.010	$0.013	-	$0.010	$0.014	-	$0.010
Conglomer	$0.012	-	$0.009	$0.012	-	$0.009	$0.012	-	$0.009
Breccia	$0.009	-	$0.007	$0.009	-	$0.007	$0.009	-	$0.007
Limestone	$0.010	-	$0.008	$0.011	-	$0.008	$0.011	-	$0.008
Schist	$0.009	-	$0.007	$0.009	-	$0.007	$0.009	-	$0.007
Slate	$0.013	-	$0.009	$0.013	-	$0.009	$0.013	-	$0.010
Gneiss	$0.014	-	$0.010	$0.014	-	$0.010	$0.014	-	$0.011

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	5.50 inch	6 inch	6.75
30,000 lbs.	1,263 psi	1,061 psi	838

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM45 -Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	5.00			6.75			7.875		
Granite	3,619	-	4,897	3,358	-	4,543	3,231	-	4,372
Basalt	1,896	-	2,565	1,759	-	2,380	1,693	-	2,290
Gabbro	2,138	-	2,893	1,984	-	2,684	1,909	-	2,582
Shale	3,798	-	5,139	3,524	-	4,768	3,391	-	4,588
Sandstone	3,960	-	5,357	3,674	-	4,971	3,535	-	4,783
Siltstone	3,942	-	5,333	3,658	-	4,948	3,519	-	4,762
Conglomer	4,549	-	6,154	4,220	-	5,710	4,061	-	5,494
Breccia	6,279	-	8,495	5,825	-	7,881	5,606	-	7,584
Limestone	5,215	-	7,056	4,839	-	6,547	4,656	-	6,300
Schist	6,395	-	8,652	5,934	-	8,028	5,710	-	7,725
Slate	4,164	-	5,634	3,864	-	5,228	3,718	-	5,030
Gneiss	3,790	-	5,128	3,517	-	4,758	3,384	-	4,578

Steel Life (feet/rod)

	Hole Diameter (inches)								
	5.00			6.75			7.875		
Granite	44,942	-	60,803	41,698	-	56,415	40,124	-	54,286
Basalt	26,314	-	35,602	24,415	-	33,033	23,494	-	31,786
Gabbro	29,065	-	39,323	26,967	-	36,485	25,950	-	35,108
Shale	46,772	-	63,280	43,397	-	58,713	41,759	-	56,497
Sandstone	48,412	-	65,499	44,919	-	60,772	43,223	-	58,478
Siltstone	48,234	-	65,258	44,753	-	60,548	43,064	-	58,263
Conglomer	54,302	-	73,468	50,383	-	68,166	48,482	-	65,593
Breccia	70,909	-	95,936	65,792	-	89,013	63,309	-	85,653
Limestone	60,812	-	82,275	56,423	-	76,337	54,293	-	73,456
Schist	71,998	-	97,409	66,802	-	90,379	64,280	-	86,968
Slate	50,476	-	68,291	46,833	-	63,362	45,065	-	60,971
Gneiss	46,689	-	63,168	43,320	-	58,609	41,685	-	56,397

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	5.00			6.75			7.875		
Granite	50	-	68	27	-	37	20	-	27
Basalt	29	-	39	16	-	21	12	-	16
Gabbro	32	-	44	17	-	24	13	-	17
Shale	52	-	71	28	-	38	21	-	28
Sandstone	54	-	73	29	-	40	21	-	29
Siltstone	54	-	73	29	-	40	21	-	29
Conglomer	61	-	82	33	-	45	24	-	33
Breccia	80	-	108	43	-	59	32	-	43
Limestone	68	-	92	37	-	50	27	-	37
Schist	81	-	109	44	-	59	32	-	44
Slate	56	-	76	31	-	41	22	-	30
Gneiss	52	-	70	28	-	38	21	-	28

	5.00 inch	7 inch	7.88 inch
45,000 lbs.	2,292 psi	1,258 psi	924 psi

Ingersoll-Rand DM45 -Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	5.00			6.75			7.875		
Granite	$0.51	-	$0.38	$0.63	-	$0.47	$0.81	-	$0.60
Basalt	$0.97	-	$0.72	$1.21	-	$0.89	$1.54	-	$1.14
Gabbro	$0.86	-	$0.64	$1.07	-	$0.79	$1.37	-	$1.01
Shale	$0.48	-	$0.36	$0.60	-	$0.45	$0.77	-	$0.57
Sandstone	$0.46	-	$0.34	$0.58	-	$0.43	$0.74	-	$0.55
Siltstone	$0.47	-	$0.35	$0.58	-	$0.43	$0.74	-	$0.55
Conglomer	$0.40	-	$0.30	$0.50	-	$0.37	$0.64	-	$0.48
Breccia	$0.29	-	$0.22	$0.37	-	$0.27	$0.47	-	$0.34
Limestone	$0.35	-	$0.26	$0.44	-	$0.33	$0.56	-	$0.41
Schist	$0.29	-	$0.21	$0.36	-	$0.27	$0.46	-	$0.34
Slate	$0.44	-	$0.33	$0.55	-	$0.41	$0.70	-	$0.52
Gneiss	$0.49	-	$0.36	$0.61	-	$0.45	$0.77	-	$0.57

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	5.00			6.75			7.875		
Granite	$0.006	-	$0.005	$0.015	-	$0.011	$0.018	-	$0.013
Basalt	$0.011	-	$0.008	$0.025	-	$0.019	$0.030	-	$0.022
Gabbro	$0.010	-	$0.007	$0.023	-	$0.017	$0.027	-	$0.020
Shale	$0.006	-	$0.004	$0.014	-	$0.011	$0.017	-	$0.013
Sandstone	$0.006	-	$0.004	$0.014	-	$0.010	$0.016	-	$0.012
Siltstone	$0.006	-	$0.004	$0.014	-	$0.010	$0.016	-	$0.012
Conglomer	$0.005	-	$0.004	$0.012	-	$0.009	$0.015	-	$0.011
Breccia	$0.004	-	$0.003	$0.009	-	$0.007	$0.011	-	$0.008
Limestone	$0.005	-	$0.003	$0.011	-	$0.008	$0.013	-	$0.010
Schist	$0.004	-	$0.003	$0.009	-	$0.007	$0.011	-	$0.008
Slate	$0.006	-	$0.004	$0.013	-	$0.010	$0.016	-	$0.012
Gneiss	$0.006	-	$0.004	$0.014	-	$0.011	$0.017	-	$0.013

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	5.00 inch	6.75 inch	7.88
45,000 lbs.	2,292 psi	1,258 psi	924

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Ingersoll-Rand DM M2 -Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	9.00			9.875			11.00		
Granite	3,312	-	4,481	3,236	-	4,378	3,150	-	4,262
Basalt	1,735	-	2,347	1,695	-	2,294	1,650	-	2,233
Gabbro	1,956	-	2,647	1,912	-	2,586	1,861	-	2,518
Shale	3,476	-	4,702	3,396	-	4,595	3,306	-	4,473
Sandstone	3,623	-	4,902	3,540	-	4,790	3,446	-	4,663
Siltstone	3,607	-	4,880	3,525	-	4,769	3,431	-	4,642
Conglomer	4,162	-	5,631	4,067	-	5,502	3,959	-	5,356
Breccia	5,745	-	7,773	5,614	-	7,595	5,465	-	7,393
Limestone	4,772	-	6,457	4,663	-	6,309	4,539	-	6,141
Schist	5,852	-	7,917	5,718	-	7,736	5,566	-	7,531
Slate	3,811	-	5,156	3,723	-	5,038	3,624	-	4,904
Gneiss	3,468	-	4,692	3,389	-	4,585	3,299	-	4,463

Steel Life (feet/rod)

	Hole Diameter (inches)								
	9.00			9.875			11.00		
Granite	41,124	-	55,639	40,183	-	54,365	39,115	-	52,921
Basalt	24,079	-	32,578	23,528	-	31,832	22,903	-	30,986
Gabbro	26,596	-	35,983	25,987	-	35,159	25,297	-	34,225
Shale	42,800	-	57,905	41,820	-	56,580	40,709	-	55,077
Sandstone	44,300	-	59,936	43,286	-	58,564	42,136	-	57,008
Siltstone	44,137	-	59,715	43,127	-	58,348	41,981	-	56,798
Conglomer	49,690	-	67,228	48,552	-	65,689	47,262	-	63,943
Breccia	64,887	-	87,788	63,401	-	85,778	61,717	-	83,499
Limestone	55,647	-	75,287	54,373	-	73,563	52,928	-	71,609
Schist	65,883	-	89,135	64,374	-	87,095	62,664	-	84,781
Slate	46,189	-	62,490	45,131	-	61,060	43,932	-	59,438
Gneiss	42,724	-	57,803	41,746	-	56,479	40,637	-	54,979

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	9.00			9.875			11.00		
Granite	21	-	29	18	-	24	14	-	19
Basalt	12	-	17	10	-	14	8	-	11
Gabbro	14	-	18	11	-	15	9	-	12
Shale	22	-	30	18	-	25	15	-	20
Sandstone	23	-	31	19	-	26	15	-	21
Siltstone	23	-	31	19	-	26	15	-	21
Conglomer	26	-	35	21	-	29	17	-	23
Breccia	34	-	46	28	-	38	22	-	30
Limestone	29	-	39	24	-	32	19	-	26
Schist	34	-	46	28	-	38	23	-	31
Slate	24	-	32	20	-	27	16	-	22
Gneiss	22	-	30	18	-	25	15	-	20

	9 inch	10 inch	11 inch
75,000 lbs.	1,179 psi	979 psi	789 psi

Ingersoll-Rand DM M2 -Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	9.00			9.875			11.00		
Granite	$0.94	-	$0.69	$1.28	-	$0.94	$1.55	-	$1.14
Basalt	$1.79	-	$1.32	$2.44	-	$1.80	$2.95	-	$2.18
Gabbro	$1.59	-	$1.17	$2.16	-	$1.60	$2.62	-	$1.94
Shale	$0.89	-	$0.66	$1.22	-	$0.90	$1.47	-	$1.09
Sandstone	$0.86	-	$0.63	$1.17	-	$0.86	$1.41	-	$1.05
Siltstone	$0.86	-	$0.64	$1.17	-	$0.87	$1.42	-	$1.05
Conglomer	$0.75	-	$0.55	$1.02	-	$0.75	$1.23	-	$0.91
Breccia	$0.54	-	$0.40	$0.74	-	$0.54	$0.89	-	$0.66
Limestone	$0.65	-	$0.48	$0.89	-	$0.66	$1.07	-	$0.79
Schist	$0.53	-	$0.39	$0.72	-	$0.53	$0.88	-	$0.65
Slate	$0.81	-	$0.60	$1.11	-	$0.82	$1.34	-	$0.99
Gneiss	$0.89	-	$0.66	$1.22	-	$0.90	$1.48	-	$1.09

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	9.00			9.875			11.00		
Granite	$0.015	-	$0.011	$0.018	-	$0.013	$0.029	-	$0.022
Basalt	$0.025	-	$0.019	$0.031	-	$0.023	$0.050	-	$0.037
Gabbro	$0.023	-	$0.017	$0.028	-	$0.020	$0.045	-	$0.033
Shale	$0.014	-	$0.011	$0.017	-	$0.013	$0.028	-	$0.021
Sandstone	$0.014	-	$0.010	$0.017	-	$0.012	$0.027	-	$0.020
Siltstone	$0.014	-	$0.010	$0.017	-	$0.012	$0.027	-	$0.020
Conglomer	$0.012	-	$0.009	$0.015	-	$0.011	$0.024	-	$0.018
Breccia	$0.009	-	$0.007	$0.011	-	$0.008	$0.018	-	$0.014
Limestone	$0.011	-	$0.008	$0.013	-	$0.010	$0.022	-	$0.016
Schist	$0.009	-	$0.007	$0.011	-	$0.008	$0.018	-	$0.013
Slate	$0.013	-	$0.010	$0.016	-	$0.012	$0.026	-	$0.019
Gneiss	$0.014	-	$0.011	$0.017	-	$0.013	$0.028	-	$0.021

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	9 inch	9.875 inch	11
75,000 lbs.	1,179 psi	979 psi	789

Prepared by Western Mine Engineering, Inc. in cooperation with Aventurine Engineering, Inc. 2003

Bucyrus International 59R -Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	12.25			15.00			16.00		
Granite	3379.984	-	4572.919	3213.372	-	4347.504	3162.023	-	4278.031
Basalt	1770.653	-	2395.589	1683.371	-	2277.502	1656.471	-	2241.108
Gabbro	1996.573	-	2701.246	1898.155	-	2568.092	1867.823	-	2527.054
Shale	3546.993	-	4798.873	3372.149	-	4562.319	3318.263	-	4489.414
Sandstone	3697.769	-	5002.863	3515.492	-	4756.254	3459.315	-	4680.25
Siltstone	3681.304	-	4980.588	3499.839	-	4735.076	3443.912	-	4659.411
Conglomer	4247.818	-	5747.048	4038.427	-	5463.755	3973.894	-	5376.445
Breccia	5863.339	-	7932.753	5574.314	-	7541.719	5485.238	-	7421.204
Limestone	4870.335	-	6589.277	4630.259	-	6264.468	4556.268	-	6164.363
Schist	5972.24	-	8080.09	5677.846	-	7681.792	5587.116	-	7559.039
Slate	3888.976	-	5261.555	3697.274	-	5002.194	3638.192	-	4922.26
Gneiss	3539.394	-	4788.591	3364.924	-	4552.544	#REF!	-	4479.796

Steel Life (feet/rod)

	Hole Diameter (inches)								
	12.25			15.00			16.00		
Granite	41969.55	-	56782.33	39900.72	-	53983.32	39263.11	-	53120.68
Basalt	24574.25	-	33247.51	23362.89	-	31608.62	22989.56	-	31103.52
Gabbro	27142.87	-	36722.71	25804.9	-	34912.52	25392.55	-	34354.62
Shale	43679.22	-	59095.42	41526.11	-	56182.39	40862.54	-	55284.61
Sandstone	45210.83	-	61167.6	42982.23	-	58152.42	42295.38	-	57223.16
Siltstone	45044.11	-	60942.03	42823.72	-	57937.98	42139.41	-	57012.14
Conglomer	50711.07	-	68609.09	48211.33	-	65227.1	47440.93	-	64184.78
Breccia	66219.99	-	89591.75	62955.76	-	85175.45	61949.75	-	83814.36
Limestone	56790.17	-	76833.76	53990.78	-	73046.35	53128.02	-	71879.08
Schist	67236.6	-	90967.16	63922.26	-	86483.06	62900.8	-	85101.08
Slate	47137.81	-	63774.69	44814.22	-	60631	44098.1	-	59662.13
Gneiss	43601.73	-	58990.58	41452.44	-	56082.72	40790.04	-	55186.53

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	12.25			15.00			16.00		
Granite	19.00236	-	25.70907	12.60139	-	17.04894	11.05531	-	14.95719
Basalt	11.03265	-	14.92652	7.316286	-	9.898504	6.418644	-	8.684048
Gabbro	12.205	-	16.51264	8.093728	-	10.95034	7.100701	-	9.606831
Shale	19.78892	-	26.77325	13.123	-	17.75464	11.51293	-	15.57631
Sandstone	20.49398	-	27.72715	13.59055	-	18.38722	11.92312	-	16.13128
Siltstone	20.41721	-	27.62329	13.53965	-	18.31835	11.87846	-	16.07085
Conglomer	23.02897	-	31.15684	15.27163	-	20.66162	13.39794	-	18.12663
Breccia	30.19898	-	40.85745	20.02642	-	27.09456	17.56936	-	23.77031
Limestone	25.83581	-	34.95433	17.13298	-	23.17992	15.03092	-	20.33595
Schist	30.66998	-	41.49468	20.33876	-	27.51714	17.84338	-	24.14104
Slate	21.38157	-	28.92801	14.17916	-	19.18357	12.43951	-	16.82992
Gneiss	19.75326	-	26.725	13.09935	-	17.72265	11.49218	-	15.54824

	12.25 inch	15 inch	16 inch
165,000 lbs.	1,400 psi	934 psi	821 psi

Bucyrus International 59R -Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	12.25			15.00			16.00		
Granite	$1.69	-	$1.25	$2.79	-	$2.06	$3.01	-	$2.22
Basalt	$3.22	-	$2.38	$5.32	-	$3.93	$5.75	-	$4.25
Gabbro	$2.86	-	$2.11	$4.72	-	$3.49	$5.10	-	$3.77
Shale	$1.61	-	$1.19	$2.66	-	$1.96	$2.87	-	$2.12
Sandstone	$1.54	-	$1.14	$2.55	-	$1.88	$2.75	-	$2.03
Siltstone	$1.55	-	$1.15	$2.56	-	$1.89	$2.76	-	$2.04
Conglomer	$1.34	-	$0.99	$2.22	-	$1.64	$2.39	-	$1.77
Breccia	$0.97	-	$0.72	$1.61	-	$1.19	$1.74	-	$1.28
Limestone	$1.17	-	$0.87	$1.93	-	$1.43	$2.09	-	$1.54
Schist	$0.96	-	$0.71	$1.58	-	$1.17	$1.70	-	$1.26
Slate	$1.47	-	$1.08	$2.42	-	$1.79	$2.62	-	$1.93
Gneiss	$1.61	-	$1.19	$2.66	-	$1.97	#REF!	-	$2.12

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	12.25			15.00			16.00		
Granite	$0.027	-	$0.020	$0.040	-	$0.030	$0.041	-	$0.030
Basalt	$0.046	-	$0.034	$0.068	-	$0.051	$0.070	-	$0.051
Gabbro	$0.042	-	$0.031	$0.062	-	$0.046	$0.063	-	$0.047
Shale	$0.026	-	$0.019	$0.039	-	$0.028	$0.039	-	$0.029
Sandstone	$0.025	-	$0.019	$0.037	-	$0.028	$0.038	-	$0.028
Siltstone	$0.025	-	$0.019	$0.037	-	$0.028	$0.038	-	$0.028
Conglomer	$0.022	-	$0.017	$0.033	-	$0.025	$0.034	-	$0.025
Breccia	$0.017	-	$0.013	$0.025	-	$0.019	$0.026	-	$0.019
Limestone	$0.020	-	$0.015	$0.030	-	$0.022	$0.030	-	$0.022
Schist	$0.017	-	$0.013	$0.025	-	$0.019	$0.025	-	$0.019
Slate	$0.024	-	$0.018	$0.036	-	$0.026	$0.036	-	$0.027
Gneiss	$0.026	-	$0.019	$0.039	-	$0.029	$0.039	-	$0.029

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	12.25 inch	15 inch	16
165,000 lbs.	1,400 psi	934 psi	821

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Ingersoll-Rand TBH4 - Rotary

Bit Life (feet/bit)

	Hole Diameter (inches)								
	5.00			6.750			7.875		
Granite	3,526	-	4,770	3,271	-	4,426	3,148	-	4,259
Basalt	1,847	-	2,499	1,714	-	2,319	1,649	-	2,231
Gabbro	2,083	-	2,818	1,932	-	2,614	1,859	-	2,516
Shale	3,700	-	5,006	3,433	-	4,645	3,303	-	4,469
Sandstone	3,857	-	5,219	3,579	-	4,842	3,444	-	4,659
Siltstone	3,840	-	5,195	3,563	-	4,820	3,428	-	4,638
Conglomera	4,431	-	5,995	4,111	-	5,562	3,956	-	5,352
Breccia	6,116	-	8,275	5,675	-	7,678	5,461	-	7,388
Limestone	5,080	-	6,873	4,714	-	6,377	4,536	-	6,137
Schist	6,230	-	8,429	5,780	-	7,820	5,562	-	7,525
Slate	4,057	-	5,488	3,764	-	5,092	3,622	-	4,900
Gneiss	3,692	-	4,995	3,426	-	4,635	3,296	-	4,460

Steel Life (feet/rod)

	Hole Diameter (inches)								
	5.00			6.750			7.875		
Granite	43,780	-	59,231	40,620	-	54,957	39,087	-	52,882
Basalt	25,634	-	34,681	23,784	-	32,178	22,886	-	30,964
Gabbro	28,313	-	38,306	26,270	-	35,542	25,279	-	34,200
Shale	45,563	-	61,644	42,275	-	57,195	40,679	-	55,036
Sandstone	47,161	-	63,806	43,757	-	59,201	42,106	-	56,966
Siltstone	46,987	-	63,570	43,596	-	58,983	41,950	-	56,756
Conglomera	52,898	-	71,568	49,081	-	66,403	47,228	-	63,897
Breccia	69,076	-	93,456	64,091	-	86,711	61,672	-	83,438
Limestone	59,239	-	80,147	54,964	-	74,363	52,890	-	71,556
Schist	70,136	-	94,890	65,075	-	88,042	62,618	-	84,719
Slate	49,171	-	66,525	45,622	-	61,724	43,900	-	59,394
Gneiss	45,482	-	61,535	42,200	-	57,094	40,607	-	54,939

Penetration Rate (feet/hour)

	Hole Diameter (inches)								
	5.00			6.750			7.875		
Granite	45	-	60	24	-	33	18	-	24
Basalt	26	-	35	14	-	19	10	-	14
Gabbro	29	-	39	16	-	21	11	-	15
Shale	46	-	63	25	-	34	18	-	25
Sandstone	48	-	65	26	-	35	19	-	26
Siltstone	48	-	65	26	-	35	19	-	26
Conglomera	54	-	73	29	-	40	22	-	29
Breccia	71	-	96	39	-	52	28	-	38
Limestone	61	-	82	33	-	45	24	-	33
Schist	72	-	97	39	-	53	29	-	39
Slate	50	-	68	27	-	37	20	-	27
Gneiss	46	-	63	25	-	34	18	-	25

	5.000 inch	6.750 inch	7.875 inch
37,700 lbs.	1,920 psi	1,054 psi	774 psi

Ingersoll-Rand TBH4 - Rotary

Bit Cost ($/foot)

	Hole Diameter (inches)								
	5.00			6.750			7.875		
Granite	$0.40	-	$0.29	$0.65	-	$0.48	$0.83	-	$0.61
Basalt	$0.76	-	$0.56	$1.24	-	$0.92	$1.58	-	$1.17
Gabbro	$0.68	-	$0.50	$1.10	-	$0.81	$1.40	-	$1.04
Shale	$0.38	-	$0.28	$0.62	-	$0.46	$0.79	-	$0.58
Sandstone	$0.36	-	$0.27	$0.59	-	$0.44	$0.76	-	$0.56
Siltstone	$0.37	-	$0.27	$0.60	-	$0.44	$0.76	-	$0.56
Conglomer	$0.32	-	$0.23	$0.52	-	$0.38	$0.66	-	$0.49
Breccia	$0.23	-	$0.17	$0.38	-	$0.28	$0.48	-	$0.35
Limestone	$0.28	-	$0.20	$0.45	-	$0.33	$0.58	-	$0.43
Schist	$0.23	-	$0.17	$0.37	-	$0.27	$0.47	-	$0.35
Slate	$0.35	-	$0.26	$0.57	-	$0.42	$0.72	-	$0.53
Gneiss	$0.38	-	$0.28	$0.62	-	$0.46	$0.79	-	$0.59

Steel Cost ($/foot per rod)

	Hole Diameter (inches)								
	5.00			6.750			7.875		
Granite	$0.013	-	$0.010	$0.015	-	$0.011	$0.018	-	$0.014
Basalt	$0.023	-	$0.017	$0.026	-	$0.019	$0.031	-	$0.023
Gabbro	$0.021	-	$0.015	$0.023	-	$0.017	$0.028	-	$0.021
Shale	$0.013	-	$0.010	$0.014	-	$0.011	$0.018	-	$0.013
Sandstone	$0.012	-	$0.009	$0.014	-	$0.010	$0.017	-	$0.013
Siltstone	$0.012	-	$0.009	$0.014	-	$0.010	$0.017	-	$0.013
Conglomer	$0.011	-	$0.008	$0.012	-	$0.009	$0.015	-	$0.011
Breccia	$0.008	-	$0.006	$0.010	-	$0.007	$0.012	-	$0.009
Limestone	$0.010	-	$0.007	$0.011	-	$0.008	$0.014	-	$0.010
Schist	$0.008	-	$0.006	$0.009	-	$0.007	$0.011	-	$0.008
Slate	$0.012	-	$0.009	$0.013	-	$0.010	$0.016	-	$0.012
Gneiss	$0.013	-	$0.010	$0.014	-	$0.011	$0.018	-	$0.013

(Based on 12 foot drilling rod length.)

Steel Cost Adjustment Factor

Number of rods	Factor
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0
10	5.5

The total steel cost per foot of hole drilled depends upon the length of the rods to be used and the number of rods needed to drill the hole. To adjust the steel cost per foot per rod as listed above for these two variables, first divide the rod length to be used (in feet) by 12 (the base case rod length). Then multiply the resulting quotient by the appropriate steel cost per foot per rod from the table above. Then multiply that result by the appropriate factor from the table at left for the number of rods needed to drill the hole. The result is the total steel cost per foot of hole drilled.

	5.000 inch	6.750 inch	7.875
37,700 lbs.	1,920 psi	1,054 psi	774

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59R

Max. hole size: 444 mm (17-1/2 in)
Max. bit loading: 74,830 kg (165,000 lbs)
Working weight: 183,673 kg (405,000 lbs)

49RIII

Max. hole size: 406 mm (16 in)
Max. bit loading: 63,975 kg (141,000 lbs)
Working weight: 154,224 kg (340,000 lbs)

39HR

Max. hole size: 349 mm (13-3/4 in)
Max. bit loading: 55,000 kg (122,000 lbs)
Working weight: 122,500 kg (270,000 lbs)

35HR Series

Max. hole size: 270 mm (10-5/8 in)
Max. bit loading: 34,000 kg (75,000 lbs)
Working weight: 54,432 kg (120,000 lbs)

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Infrastructure - Drilling Solutions

Drilling Solutions

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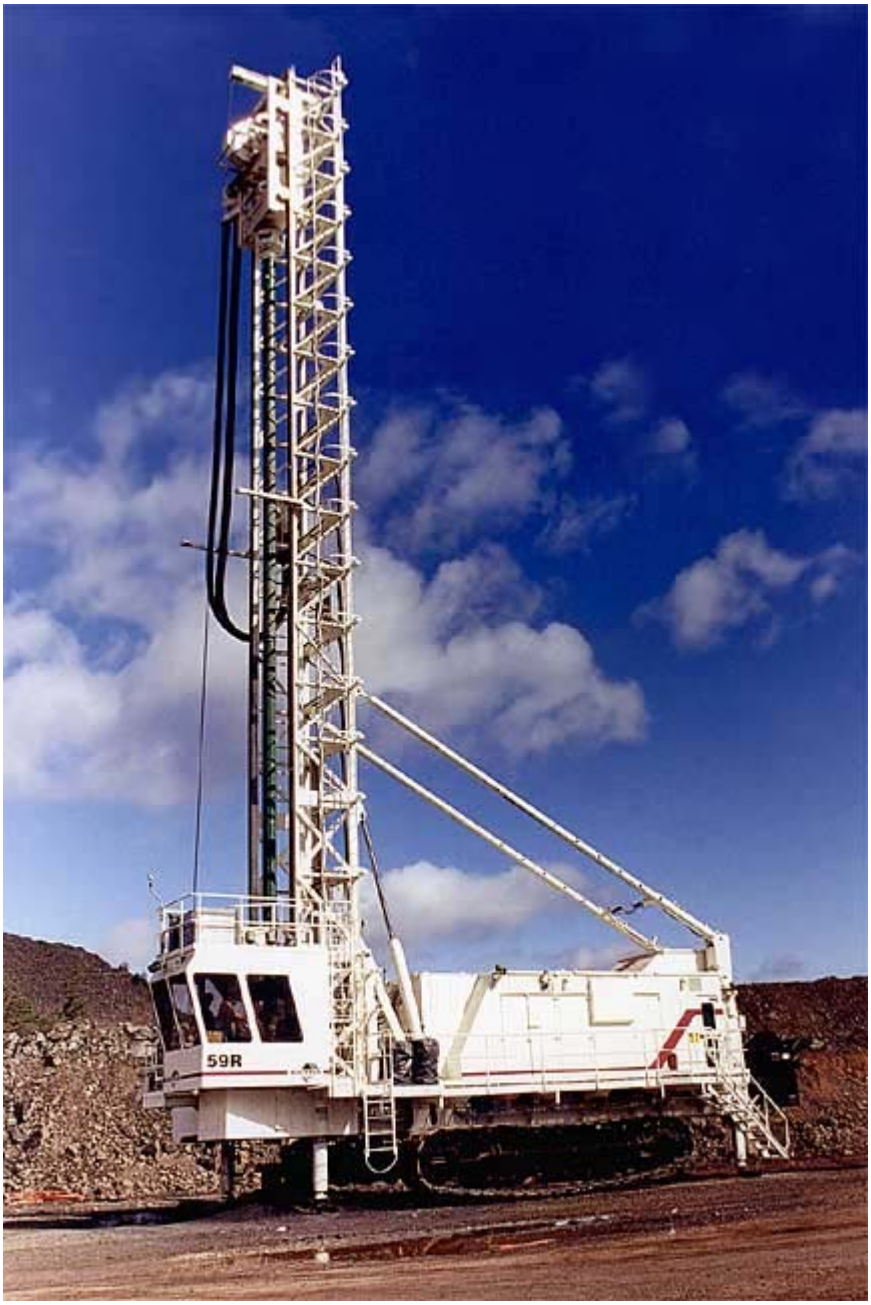
59R

Infrastructure - Drilling Solutions

Rotary - DM45/LP

Select Model:

T4BH
DM25/SP
DM30
DM45/LP
DM50/LP
DM-L/LP
DM45/SP
DM-LSP
DM-M2
DM-M3
DM-H2
351

The DM45/LP is a hydraulic rotary head drive, multi-pass, crawler-mounted drill rig with a 45,000 lb. (20,400 kg) bit load capacity. The standard two-motor spur gear rotary head is rated from 9,000 ft-lb. (12,204 N-m) at 0-100 RPM and 5,400 ft-lb. (732 N-m) at 0-160 RPM. The DM45/LP can drill from 5-1/8 to 7-7/8 in. (130 to 200 mm) diameter blastholes to depths of 180 ft. (55 m) with a 30 ft. (9.1 m) drill pipe change. Two low-pressure Ingersoll-Rand compressor options are available with your choice of Caterpillar or Cummins engines.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	6-8 in.
Power Pack	
Engine #1	Cummins QSX15 (425 HP @ 1800 rpm)
Compressor #1	900 @ 110 CFM @ PSI / 25.5 @ 758 m3/min@kPA
Engine #2	CAT C15 (425 HP @ 1800 RPM)
Compressor #2	900 @ 110 CFM @ PSI / 25.5 @ 758 m3/min@kPA
Engine #3	Cummins QSX15 (475 HP @ 1800 RPM)
Compressor #3	1050 @ 110 CFM @ PSI / 29.7 @ 758 m3/min@kPA
Engine #4	Cat C15 (475 HP @ 1800 RPM)
Compressor #4	1050 @ 110 CFM @ PSI / 29.7 @ 758 m3/min@kPA
Rotation	
Type	2-motor variable displacement, high torque/high speed
Head Torque	High torque: 9,000 ft-lb @ 100 rpm
Speed	High speed: 5,400 ft-lb @ 160 rpm rpm
Feed System	
Type	Hydraulic cyls. w/cable pulldown & chain pullback
Bit Load	45,000 lb / 20,411 kg
Tower	
Pipe Length	30 ft. / 9.1 m.
Fabrication	4-member open front w/rectangular hollow steel tubing/double cut lacing
Undercarriage	
Model	Caterpillar 325L or equivalent

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Length	15.3 ft. / 4.66 m
Carousel	
Capacity	Capable of 180 ft.
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	43 ft. / 13.11 m
Approx. Working Weight	77,000 - 85,000 lbs. / 34,900 - 38,600 kg.
Material To Be Drilled	
Soft	Yes
Drill Application	
Mining	Yes
Quarry	Yes
Drilling Method	
Rotary	Yes

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Infrastructure - Drilling Solutions

Rotary - DM30

Select Model:

- T4BH
- DM25/SP
- DM30
- DM45/LP
- DM50/LP
- DM-L/LP
- DM45/SP
- DM-LSP
- DM-M2
- DM-M3
- DM-H2
- 351

The DM30 is a hydraulic tophead drive, multi-pass, crawler-mounted drill rig designed for blastholes ranging from 5-1/8 to 6-3/4 in. (130 to 171 mm) in diameter. On-board depth capability is up to 150 ft. (45.7 m). For rotary drilling, the DM30 can assert a bit load force up to 30,000 lb. (13,608 kg) and rotation speeds of 0-130 RPM. This rig can also be used with downhole drills when equipped with a high-pressure air compressor option.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	5-6 in.
Power Pack	
Engine #1	Cummins QSX15 (525 HP @ 1800 RPM)
Compressor #1	IR HR2 900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #2	CAT C15 (525 HP @ 1800 RPM)
Compressor #2	IR HR2 900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #3	Cummins QSX15 (425 HP @ 1800 RPM)
Compressor #3	IR WW226 900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Engine #4	CAT C15 (425 HP @ 1800 RPM)
Compressor #4	IR WW226 900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Floating Sub Base	Isolates components from drilling and propel shock loads/maintains alignment
Rotation	
Type	Rotary Tophead
Head Torque	5,400 ft-lb. / 7,322 N-m
Speed	0-100 rpm
Feed System	
Type	Single cylinder, cable feed
Bit Load	30,000 lb / (13,608) kg
Tower	
Pipe Length	30 ft. / 9.1 m.
Construction	4 member open front with hollow steel tubing.

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Undercarriage	
Manufacturer	Caterpillar
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	44.3 ft. / 13.4 m
Approx. Working Weight	68,000 lbs. / 30,844 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Quarry	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

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Rotary - DM25/SP

Select Model:

T4BH
DM25/SP
DM30
DM45/LP
DM50/LP
DM-L/LP
DM45/SP
DM-LSP
DM-M2
DM-M3
DM-H2
351

The DM25SP is a crawler-mounted rotary table drill rig designed for single-pass blasthole drilling to depths of up to 50 ft. (15.2 m) and diameters of 3-1/2 to 6-3/4 in. (89 to 171 mm). This drill is capable of rotary drilling with 25,000 lb. (11,340 kg) of bit load at 0-200 rpm. The DM25SP can also be used with downhole drills when equipped with a high-pressure air compressor option.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	5-6 in.
Power Pack	
Engine #1	Cummins QSX15 (525 HP @ 1800 RPM)
Compressor #1	900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #2	CAT C15 (525 HP @ 1800 RPM)
Compressor #2	900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #3	Cummins QSX15 (425 HP @ 1800 RPM)
Compressor #3	900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Engine #4	CAT C15 (425 HP @ 1800 RPM)
Compressor #4	900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Rotation	
Type	Rotary Table Drive
Speed	0-170 rpm
Torque	3,500 / (4,746 N-m)
Feed System	
Type	Heavy-duty chains through cluster sprocket
Pulldown	25,000 lbs. / 11,340 kg.
Tower	
Construction	4 main member, open front, rectangular steel tubing
#1 Single pass depth	40 ft. / 12.2 m.
#2 Single pass depth	50 ft. / 15.2 m.
Undercarriage	

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Type	Excavator
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Weight	Varies according to drill pipe: 60,000 - 62,000 lb / 27,216-28,123 kg
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Quarry	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

IR Infrastructure

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Infrastructure - Drilling Solutions

Rotary - DM-M2

Select Model:

T4BH
DM25/SP
DM30
DM45/LP
DM50/LP
DM-L/LP
DM45/SP
DM-LSP
DM-M2
DM-M3
DM-H2
351

Designed for rotary or downhole drilling of up to 10-5/8 in. (270 mm) diameter blastholes, the DM-M2 provides 75,000 lb. (34,000 kg) of bit load and a 35 ft. (10 m) drill pipe change. Advanced frame and tower design and a unique, patented carriage feed system allow on-board drill depths to 175 ft. (53 m). Compressor/engine packages in both low-pressure, [1900 CFM @ 110 PSI (51 m3/min. @ 758 kPa)] for rotary drilling and high pressure [1250 CFM @ 350 PSI (35.4 m3/min. @ 2,413 kPa)], for downhole drilling, are available.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	9-11 in.
Power Pack	
Engine #1	Caterpillar 3412E / EPA certified
Compressor #1	1900 @ 100 CFM @ PSI / 53.8 @ 690 m3/min@kPA
Engine #2	Cummins QSK19 / EPA certified
Compressor #2	1900 @ 100 CFM @ PSI / 53.8 @ 690 m3/min@kPA
Engine #3	Caterpillar 3412E / EPA certified
Compressor #3	1250 @ 350 CFM @ PSI / 35.4 @ 2413 m3/min@kPA
Rotation	
Type	Two-motor, variable displacement
Speed Range	0-150 rpm, variable
Head Torque	0-8,640 ft-lbs (0-11,714 Nm) (forward)
Feed System	
Type	Patented carriage feed
Weight on Bit	0 to 75,000 lb. / 0 to 34,019 kg
Tower	
Pipe Length	35 ft. / 10.7 m.
Construction	4 member open front with hollow steel tubing.
Undercarriage	
Model	Caterpillar 330EL or equivalent
Carousel	
Size	Holds 2 to 4 drill pipe depending on pipe diameter

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Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	56.2 ft. / 17.1 m
Approx. Working Weight	120,000 - 133,500 lbs. / 54,400 - 60,555 kg.
Material To Be Drilled	
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

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Infrastructure - Drilling Solutions

Rotary - T4BH

Select Model:

- T4BH
- DM25/SP
- DM30
- DM45/LP
- DM50/LP
- DM-L/LP
- DM45/SP
- DM-LSP
- DM-M2
- DM-M3
- DM-H2
- 351

The T4BH is a truck-mounted, hydraulic tophead drive multipass rotary drill specificaly designed for production blasthole drilling to depths of 150 ft. (45.7 m) with a 25 ft. (7.6 m) drill pipe change. Nominal hole size is 5-1/8 to 7-7/8 in. (130 to 200 mm) for rotary or DHD drilling methods. Feed pressure generates a bit load force of up to 30,000 lb. (12,610 kg). An angle drilling option is available. All drill functions are controlled from the newly designed operator cab.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	6-9 in.
Carrier	
Chassis (Standard)	Crane Carrier, Custom, 3 axle, 6X4
Engine	CAT C10 (305 HP)
Power Pack	
Engine #1	Cummins QSX19 (525 HP @ 1800 RPM)
Compressor #1	IR HR2-900/350 CFM @ PSI / 25.5/2413 m3/min@kPA
Engine #2	Cummins QSX19 (600 HP @ 1800 RPM)
Compressor #2	1050 @ 350 CFM @ PSI / 129.7 @ 2413 m3/min@kPA
Engine #3	Cummins QSK-19C (700 HP @ 2100 RPM)
Compressor #3	IR HR2.5 - 1250/350 CFM @ PSI / (35.39 @ 2413) m3/min@kPA
Floating Sub Base	Isolates components from drilling and propel shock loads/maintains alignment
Rotation	
Type	Rotary Tophead
Speed Range	0-160 RPM (std.)
Head Torque	6,500 ft-lb. / (8,814 N-m)
Option	7,165 ft-lb @ 0-130 RPM / 9,716 N-m @ 0-130 RPM
Feed System	
Type	Hydraulic cylinders w/cable and chain
Pulldown	0-37,700 lbs. / 17,108 kg.

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Tower	
Pipe Length	25 ft. / 7.6 m.
Construction	4 member open front with ASTM A500 GRB steel tubing.
Cab & Controls	
Operator Cab	New cab designed to optimize operator comfort and safety
Controls	All operational functions controlled from driller console in cab
Options	
Option #1	Contact your local distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	28-3/4 ft. / 8.7 m
Approx. Working Weight	58,000 lbs. / 26,309 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Quarry	Yes
Drilling Method	
Rotary	Yes

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DHD - DM-M2

Select Model:

CM695D
DM25/SP
DM30
DM45/HP
DM45/SP
DM-L/HP
DM-M2

Designed for rotary or downhole drilling of up to 10-5/8 in. (270 mm) diameter blastholes, the DM-M2 provides 75,000 lb. (34,000 kg) of bit load and a 35 ft. (10 m) drill pipe change. Advanced frame and tower design and a unique, patented carriage feed system allow on-board drill depths to 175 ft. (53 m). Compressor/engine packages in both low-pressure, [1900 CFM @ 110 PSI (51 m3/min. @ 758 kPa)] for rotary drilling and high pressure [1250 CFM @ 350 PSI (35.4 m3/min. @ 2,413 kPa)], for downhole drilling, are available.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	9-11 in.
Power Pack	
Engine #1	Caterpillar 3412E / EPA certified
Compressor #1	1900 @ 100 CFM @ PSI / 53.8 @ 690 m3/min@kPA
Engine #2	Cummins QSK19 / EPA certified
Compressor #2	1900 @ 100 CFM @ PSI / 53.8 @ 690 m3/min@kPA
Engine #3	Caterpillar 3412E / EPA certified
Compressor #3	1250 @ 350 CFM @ PSI / 35.4 @ 2413 m3/min@kPA
Rotation	
Type	Two-motor, variable displacement
Speed Range	0-150 rpm, variable
Head Torque	0-8,640 ft-lbs (0-11,714 Nm) (forward)
Feed System	
Type	Patented carriage feed
Weight on Bit	0 to 75,000 lb. / 0 to 34,019 kg
Tower	
Pipe Length	35 ft. / 10.7 m.
Construction	4 member open front with hollow steel tubing.
Undercarriage	
Model	Caterpillar 330EL or equivalent
Carousel	
Size	Holds 2 to 4 drill pipe depending on pipe diameter

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Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	56.2 ft. / 17.1 m
Approx. Working Weight	120,000 - 133,500 lbs. / 54,400 - 60,555 kg.
Material To Be Drilled	
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

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DHD - DM30

Select Model:

CM695D
DM25/SP
DM30
DM45/HP
DM45/SP
DM-L/HP
DM-M2

The DM30 is a hydraulic tophead drive, multi-pass, crawler-mounted drill rig designed for blastholes ranging from 5-1/8 to 6-3/4 in. (130 to 171 mm) in diameter. On-board depth capability is up to 150 ft. (45.7 m). For rotary drilling, the DM30 can assert a bit load force up to 30,000 lb. (13,608 kg) and rotation speeds of 0-130 RPM. This rig can also be used with downhole drills when equipped with a high-pressure air compressor option.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	5-6 in.
Power Pack	
Engine #1	Cummins QSX15 (525 HP @ 1800 RPM)
Compressor #1	IR HR2 900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #2	CAT C15 (525 HP @ 1800 RPM)
Compressor #2	IR HR2 900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #3	Cummins QSX15 (425 HP @ 1800 RPM)
Compressor #3	IR WW226 900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Engine #4	CAT C15 (425 HP @ 1800 RPM)
Compressor #4	IR WW226 900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Floating Sub Base	Isolates components from drilling and propel shock loads/maintains alignment
Rotation	
Type	Rotary Tophead
Head Torque	5,400 ft-lb. / 7,322 N-m
Speed	0-100 rpm
Feed System	
Type	Single cylinder, cable feed
Bit Load	30,000 lb / (13,608) kg
Tower	
Pipe Length	30 ft. / 9.1 m.
Construction	4 member open front with hollow steel tubing.

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Undercarriage	
Manufacturer	Caterpillar
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	44.3 ft. / 13.4 m
Approx. Working Weight	68,000 lbs. / 30,844 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Quarry	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

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DHD - DM25/SP

Select Model:

CM695D
DM25/SP
DM30
DM45/HP
DM45/SP
DM-L/HP
DM-M2

The DM25SP is a crawler-mounted rotary table drill rig designed for single-pass blasthole drilling to depths of up to 50 ft. (15.2 m) and diameters of 3-1/2 to 6-3/4 in. (89 to 171 mm). This drill is capable of rotary drilling with 25,000 lb. (11,340 kg) of bit load at 0-200 rpm. The DM25SP can also be used with downhole drills when equipped with a high-pressure air compressor option.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	5-6 in.
Power Pack	
Engine #1	Cummins QSX15 (525 HP @ 1800 RPM)
Compressor #1	900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #2	CAT C15 (525 HP @ 1800 RPM)
Compressor #2	900/350 CFM @ PSI / 25.5/2,413 m3/min@kPA
Engine #3	Cummins QSX15 (425 HP @ 1800 RPM)
Compressor #3	900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Engine #4	CAT C15 (425 HP @ 1800 RPM)
Compressor #4	900/110 CFM @ PSI / 25.5/758 m3/min@kPA
Rotation	
Type	Rotary Table Drive
Speed	0-170 rpm
Torque	3,500 / (4,746 N-m)
Feed System	
Type	Heavy-duty chains through cluster sprocket
Pulldown	25,000 lbs. / 11,340 kg.
Tower	
Construction	4 main member, open front, rectangular steel tubing
#1 Single pass depth	40 ft. / 12.2 m.
#2 Single pass depth	50 ft. / 15.2 m.
Undercarriage	

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Type	Excavator
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Weight	Varies according to drill pipe: 60,000 - 62,000 lb / 27,216-28,123 kg
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Quarry	Yes
Drilling Method	
Rotary	Yes
DHD	Yes

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DHD - DM45/SP

Select Model:

- CM695D
- DM25/SP
- DM30
- DM45/HP
- DM45/SP
- DM-L/HP
- DM-M2

The DM45/SP is a crawler-mounted hydraulic rotary table drive, drill rig designed to produce 50 ft. (15.2 m) of clean hole in a single pass. Hole diameter capability is 5-1/2 to 6-3/4 in. (139.7 to 171.5 mm) to a depth of up to 50 ft. (15.2 m) with a downhole hammer (high-pressure air package). Feed pressure generates a bit load force of up to 25,000 lb. (11,340 kg). An optional angle drilling system is available.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	5-7 in.
Power Pack	
Engine #1	Cummins QSX15 (525 HP @ 1800 RPM)
Compressor #1	900/350 CFM @ PSI / 25.5/2413 m3/min@kPA
Engine #2	CAT C15 (525 HP @ 1800 RPM)
Compressor #2	900/350 CFM @ PSI / 25.5/2413 m3/min@kPA
Engine #3	Cummins QSX15 (600 HP @ 1800 RPM)
Compressor #3	1070/350 CFM @ PSI / 30.30/2,413 m3/min@kPA
Engine #4	CAT C16 (600 HP @ 1800 RPM)
Compressor #4	1070/350 CFM @ PSI / 30.30/2413 m3/min@kPA
Rotation	
Type	Rotary table w/kelly drive
Speed	0-200 rpm
Torque	4,000 ft-lb / (5,424 N-m)
Feed System	
Type	Chain and cable
Pulldown	25,000 lbs. / 11,340 kg.
Tower	
Type	Single Pass
Pipe Length	50 ft. / 15.2 m.
	4 member open front with rectangular steel

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Construction	tubing
Undercarriage	
Type	Excavator-type
Options	
Option #1	Contact your local IR distributor for a complete list of options.
Weight & Dimensions	
Height (Tower Up)	76-1/2 ft. / 23.3 m
Approx. Working Weight	75,000 - 78,000 lbs. / 34,020 - 35,400 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Drill Application	
Mining	Yes
Quarry	Yes
Drilling Method	
DHD	Yes

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Pneumatic Crawler - ECM350

Select Model:

- LM100A
- CM348
- ECM350

This agile, powerfull drill climbs steep grades over roughest ground, and takes the punishment. You have seen thousands of them on construction jobs of all kinds around the world. The basic ECM350 design has seen many improvements in its years of service ? but every drill produced has set the world standard for reliability and perfomance in its time. The ECM350 is also a fine quarry drill when teamed with an Ingersoll-Rand air compressor. This high-performance team gets more work done faster, more efficiently, and keeps doing it longer than anything else in its class.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	2-1/2 - 5-1/2 in.
Drifter	
Drifter #1	VL140
Hole Diameter #1	2.5-4 " / 64-102 mm
Rotation Speed #1	0 - 72 rpm
Frequency #1	2100 BPM
Air Consumption #1	750 SCFM @ 100 PSI / 21.2 m3/min @ 7 kg/cm2
Stroke #1	5-1/2 in. / 140 mm.
Bore #1	5-1/2 in. / 140 mm.
Weight #1	421 lb. / 191 kg.
Guide	
Guide Dump #1	180 °
Guide Swing (L/R)	50 deg / 35 deg
Boom	
Boom Swing (L/R) #1	40 ° / 35 °
Boom Lift (Up/Down) #1	45 ° / 15 °
Air Rotary Head	
Weight	554 lb. / 252 kg.
Torque Max.	1492 Nm @ 8.4 kg/cm? / (1100 lb-ft @ 120 PSI)
Rotation	0 - 72
Air Consumption	120 CFM @ 50 RPM & 90 PSI / 3.4 m3/min @ 50 RPM & 6.3 kg/cm2
Gear Ratio	33:1
Horse Power	2.23 kw @ 6.3 kg/cm? (3.0 hp @ 90 psig) / 3.13 kw @ 8.4 kg/cm? (4.2 hp @ 120 psig)
General	
Feed/Pullback Force	3,000 lb / 1,361 kg

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Downhole Drills	
O.D. #1	3.62 in. / 92 mm.
Length (bit ext.) #1	45.7 in. / 1161 mm.
Air Consumption @ 10.5 kg/cm? (150 PSIG) #1	5.1 m?/min / (180 SCFM)
Air Consumption @ 17.6 kg/cm? (250 PSIG) #1	9.9 m?/min / (350 SCFM)
Drill #2	DHD350R
Hole Diameter #2	5-1/8 - 5-1/2 in. / 130-140 mm.
Weight (less bit) #2	151 lb. / 68.5 kg.
O.D. #2	4.5 in. / 114 mm.
Length (bit ext.) #2	54.6 in. / 1388 mm.
Air Consumption @ 10.5 kg/cm? (150 PSIG) #2	7.9 m?/min / (280 SCFM)
Air Consumption @ 17.6 kg/cm? (250 PSIG) #2	14.7 m?/min / (520 SCFM)
Crawlair Drill Specifications	
Net weight	12,900 lb. / 5851 kg.
Overall shipping length	12 ft. 0 in. / 3645 mm.
Width	8 ft 0 in. / 2438 mm.
Height (vertical guide)	18 ft. 10 in. / 5753 mm.
Steel change	12 ft. / 3645 mm.
Drill travel	14 ft. 3 in. / 4356 mm.
Max. horizontal boom swing	40? left, 35? right
Max. vertical boom movement	45? above, 15? below
Max. guide swing	50? left, 35? right
Max guide dump	180?
Ground clearance	12 in. / 292 mm.
Grouser width	10 in. / 254 mm.
Weight & Dimensions	
Ground Clearance	12 " / 292 mm
Shipping Width	96 " / 2438 mm
Shipping Length	144 " / 3645 mm
Approx. Working Weight	12,900 lbs. / 5851 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Construction	Yes
Quarry	Yes
Drilling Method	
Drifter	Yes

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Hydraulic Crawler - ECM-720

Select Model:

- ECM470
- ECM580
- ECM590
- ECM660II
- ECM-720

They said it couldn't be done...they were wrong. The new ECM-720 crawler drill delivers a perfect balance of productivity and cost efficiency. Hole straightness, faster penetration rates, long accessory life, and increased profitability are just a few of the results you can expect with the ECM-720.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	4-1/2 - 5-1/2 in.
Drifter	
Type	Montabert HC-200A
Boom & Guide	
Boom Swing	45 deg right / 20 deg left maximum
Vertical Boom Movement	50 deg up / 20 deg down maximum
Guide Swing	20 deg right / 90 deg left maximum
Guide Dump	135 deg maximum
Boom Extension	36 in. / 914 mm
Guide Extension	5 ft / 1,524 mm
Overall Guide Length	27 ft 6 in / 8.4 m
Drifter Travel	16 ft. 11 in. / 5.15 m
Engine	
Type	CAT 3176 C-10
Rated Power	365 HP / 272 kW
Operating Speed	1,800 rpm
Compressor	
Type	Ingersoll-Rand Rotary Screw
Volume	480 CFM / 13.6 m3/min
Pressure	150 PSI / 10.3 BAR
Cab & Controls	
Operator Cab	ROPS/FOPS
Noise level	80 dBA
General	
Gradeability	35 deg (70 percent) °
Tramming Speed	2.0 mph / 3.3 km/hr
Ground clearance	17 in. / 432 mm.
Grouser Width	13-3/4 in. / 349 mm mm.
Rod Changer Capacity	(6) 12 ft (3.66 m) / (6) 14 ft (4.27 m) opt.
Shipping Information	
Weight	45,900 lb / 20,820 kg

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Width	8 ft 3 in / 2.5 m
Length	35 ft 8 in / 10.9 m
Height	10 ft 8 in / 3.3 m
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Construction	Yes
Quarry	Yes
Drilling Method	
Drifter	Yes

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Infrastructure - Drilling Solutions

Hydraulic Crawler - ECM590

Select Model:

- ECM470
- ECM580
- ECM590
- ECM660II
- ECM-720

The ECM-590 is a self-contained, cabless hydraulic crawler drill capable of drilling up to 4 in. (102 mm) holes. It is available in either a YH70 drifter and rod rack configuration for smaller hole work, or with a YH80 and rod changer for higher production requirements. An extended guide option for 20 ft. (6.1 m) starter steel is available.

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	2-1/2 - 4-1/2 in.
Drifter	
Drifter #1	YH70
Hole Diameter #1	2.5-4 " / 64-102 mm
Rotation Speed #1	0-200 rpm
Frequency #1	2800 BPM
Weight #1	419 lb. / 190 kg.
Steel Size #1	T45/T38
Drifter #2	YH80A
Hole Diameter #2	2.5-4.5 in. / 64-114 mm.
Rotation Speed #2	0-200 rpm
Frequency #2	2600 BPM
Weight #2	462 lb. / 210 kg.
Steel Size #2	T51/T45
Hydraulic Pressure	2130 psi / 150 kg/cm?
Boom & Guide	
Horizontal Boom Swing	30 deg R / 34.6 deg L
Vertical Boom Movement	51 deg up / 15 deg down
Guide Swing	48 deg R / 40 deg L
Guide Dump	180 deg
Boom Extension - YH70 (YH80A)	48 in (30 in) / 1,219 mm (762 mm)
Drifter Travel - YH70 (YH80A)	15 ft 4 in (14 ft) / 3,099 mm (4,267 mm)
Guide Extension	4 ft / 1,219 mm
Overall Guide Length	23 ft 8 in / 7,214 mm
Engine	
Type	Cummins 6CT8.3
Rated Power	215 HP / 159 kW
Operating Speed	2350 rpm

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IR Rotary Screw Compressor	
Compressor pressure(max)	140 psig / 9.8 kg/cm2
Compressor volume	250 cfm / 7 m?/min
General	
Gradeability	35 °
Tramming Speed	2 mph / 3.3 km/hr
Grouser Width	12 in. / 305 mm.
Steel length	starter rod 14 ft. / 4.27 m.
Weight & Dimensions	
Length	232.9 " / 5918 mm
Weight #2	24,500 lb. / 11,150 kg.
Ground Clearance	18 " / 457 mm
Shipping Width	95.98 " / 2438 mm
Shipping Height	112 " / 2845 mm
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Construction	Yes
Drilling Method	
Drifter	Yes

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Infrastructure - Drilling Solutions

Pneumatic Crawler - LM100A

Select Model:

- LM100A
- CM348
- ECM350

The LM100A is a small class pneumatic Crawlair?, capable of drilling 1-3/4" to 4- 1/2" (44 - 114 mm) diameter holes. It can be equipped with either of two drifters or a BRH rotary head for downhole drilling. The LM100A is ideal for applications in confined areas where hand-held tools are not enough, and is light enough to transport by helicopter. Like all Ingersoll-Rand crawler drills, the LM100A is "Abuse Resistant". It keeps coming back for more!

[SPECS] | [FEATURES] | [LITERATURE]

Nominal Hole Diameter	
Diameter	1-3/4 - 2-1/2 in.
Carrier	
Overall Track Length	72 " / 1845 mm
Ground Clearance	9 " / 230 mm
Oscillation	20 °
Air Motors	4.5 HP
Gradeability	30 °
Tramming Speed	0-2 mph / 0-3.2 km/hr
Drifter	
Type	Ingersoll-Rand YD90
Hole Diameter #1	1.75-2.5 " / 44-64 mm
Frequency #1	1600 BPM
Air Consumption #1	375 scfm @ 100 psi & 50 rpm / 10.6 m3/min @ 7 kg/cm2 & 50 rpm
Stroke #1	3.4 in. / 85 mm.
Bore #1	3.5 in. / 90 mm.
Steel Size #1	10 ft / 3048 mm
Drifter #2	VL120
Hole Diameter #2	2 - 3.5 in. / 51 - 89 mm.
Frequency #2	1900 BPM
Air Consumption #2	600 SCFM @ 50 RPM & 100 psi / 17.0 m3/min @ 50 RPM & 7 kg/cm2
Stroke #2	3.62 in. / 92 mm.
Bore #2	4.75 in. / 120 mm.
Steel Size #2	10 ft / 3048 mm
Guide	
Guide Dump #1	75 °
Guide Swing (L/R)	45 deg/45 deg

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Guide Extension #1	29 " / 750 mm
Drill Rod Length	10 ft. / 3 m
Feed Motor Pull	3000 lbs. / 1360 kg.
Boom	
Boom Swing (L/R) #1	30/35 °
Boom Lift (Up/Down) #1	45/30 °
Coverage Length	107 " / 2720 mm
Max. Drill Height (Horizontal)	99 " / 2510 mm
BRH Rotary Head	
Weight	304 lbs. / 138 kg.
Torque Maximum	700 lb.-ft. / 96.7 kg.-m
Rotation Range	0 - 50 RPM
Air Consumption	120 SCFM @ 50 RPM & 100 psi / 3.39 m3/min @ 50 RPM & 7 kg/cm2
Gear Ratio	20:1
Horse Power @ 100 psi (7 kg/cm)	4.5 HP / 3.35 kW
Weight & Dimensions	
Width	75 " / 1905 mm
Length (Boom @45°)	195 " / 4950 mm
Minimum Height	44 " / 1120 mm
Height (Boom @45°)	188 " / 4775 mm
Hole Size	1.75-4.5 " / 44-114 mm
Weight Less Drifter	5400 lbs. / 2450 kg.
Material To Be Drilled	
Hard	Yes
Medium	Yes
Soft	Yes
Drill Application	
Mining	Yes
Construction	Yes
Quarry	Yes
Drilling Method	
Drifter	Yes

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